Atlas of Prenatal Care Utilization

California

1998

California Department of Health Services
Maternal and Child Health Branch

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California - 1998

by

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FEEDBACK

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We value your comments and questions.

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Executive Summary

- *Prenatal care is effective in mitigating a range of pregnancy-related problems. These include lowering the risks for maternal and infant mortality, low birthweight, and preterm birth. A number of cost-benefit studies have shown that prenatal care is quite cost-effective.*

- *Factors that can put a mother at risk for inadequate prenatal care include such maternal characteristics as poverty, single marital status, low-level of education, non-metropolitan residence, and cultural barriers. The mother's ability to receive adequate prenatal care can be impacted by the adequacy of the health care delivery system, and changes in assurance of a payor source.*

- *In 1989, mothers received adequate prenatal care in only 58.7% of all births. By 1998 California women received adequate prenatal care in 72.5% of all births.*

- *Between 1989 and 1998, those mothers who received their prenatal care through MediCal had the most improvement in adequate prenatal care utilization. Hispanic mothers had the largest improvement in adequate prenatal care utilization among any of the race/ethnic subgroups.*

- *Generally, the older or more educated the mother, the more likely it was that she would receive adequate prenatal care. However, between 1989 and 1998, when compared to the older or most educated mothers, less educated or younger mothers narrowed the gap.*

- *Between 1989 and 1998, there were important variations in prenatal care utilization across counties. However, all but seven of the 56 counties for which a reliable calculation could be made had an increase in the percent of adequate prenatal care utilization.*

- *In the state as a whole, 27.5% of 1998 births had inadequate prenatal care. Out of 5,858 census tracts in California, 659 census tract "hot spots" had a percent of inadequate prenatal care that was statistically significantly higher than the state. 2,531 census tracts had a percent of inadequate prenatal care that was either at or below the state.*

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- *Clusters of contiguous hot spots can be seen throughout the state. All of San Benito county and much of Butte, Imperial, Mendocino, Merced, Riverside, Stanislaus, and Yuba counties have large geographic regions of hot spots.*

- *Large numbers of births to mothers with inadequate prenatal care are heavily clustered in major population centers. The largest of these are the southeast Los Angeles-northwest Orange region, west Riverside region, southwest San Bernardino region, west San Diego region, scattered areas throughout the central valley and much of the San Francisco bay area.*

- *Although gains in prenatal care utilization in the last decade have been impressive, 27.5% of the births in California during 1998 were to mothers with inadequate prenatal care. The national objective for the year 2010 recommends that inadequate prenatal care be reduced to 10% of all births.*

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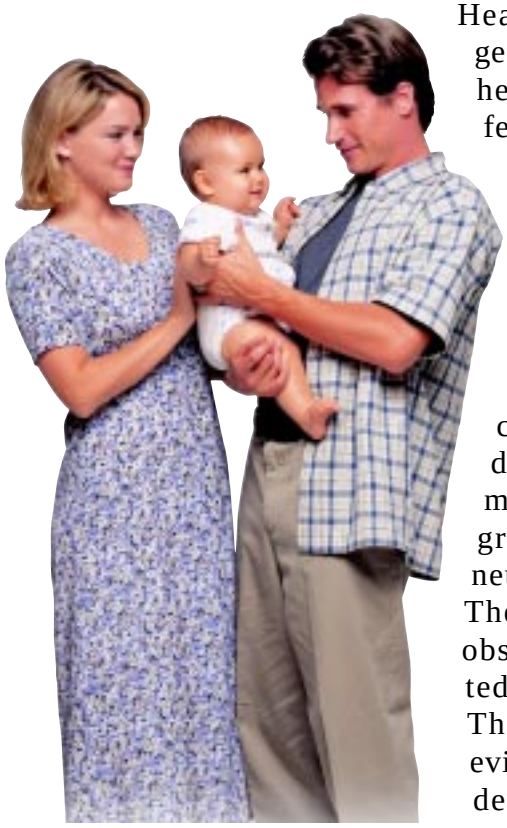
Prenatal Care Utilization in California

What is Prenatal Care?

The delivery of adequate prenatal care has three primary goals: health promotion, risk assessment, and clinical intervention.



Health promotion includes improving the patient's general knowledge of pregnancy, counseling about healthy behaviors, nutrition, amniocentesis, infection risk, alcohol and drug use, and increasing awareness of normal signs and symptoms during pregnancy. Health promotion may also include education about such post-birth topics as healthy infant growth and development, immunization, appropriate parenting skills, and child health supervision.[1,2]

The physician's risk assessment and clinical intervention include detection of conditions leading to maternal morbidity and mortality, fetal loss, preterm birth, intrauterine growth retardation, congenital anomalies, and neurological and other associated health problems. The physician will screen for genetic disease and obstetric history, dietary intake, sexually transmitted diseases, and tobacco, alcohol and drug use. The physician may also assess whether there is evidence of family violence or behavioral disorders potentially leading to child neglect.[2,3]

Why Is It Important?

Many scientific studies have overwhelmingly shown that prenatal care is effective in mitigating a range of pregnancy-related problems. These include lowering the risks for maternal and infant mortality,[4,5] low birthweight,[6-11] and preterm birth.[7,8,12-15] Prenatal care has also been shown to be a useful screening tool to effectively detect other important problems such as fetal genetic disease,[16,17] maternal infections,[18] fetal infections,[19] alcohol and drug use,[20,21] maternal smoking,[22] and domestic violence.[23]

A number of cost-benefit studies have shown that prenatal care is very cost-effective.[5,9-11,15,24] Based on reductions in the rates of low birthweight, the savings have been estimated at between $58,000 to $273,000 per prevented low birthweight baby.[11] A recent study by Kaiser-Permanente suggested that prenatal care cost-effectiveness can be improved by reducing the number of prenatal care visits among low risk women. In this study, pre-selected low risk mothers received fewer prenatal care visits without increasing negative birth outcomes.[25]

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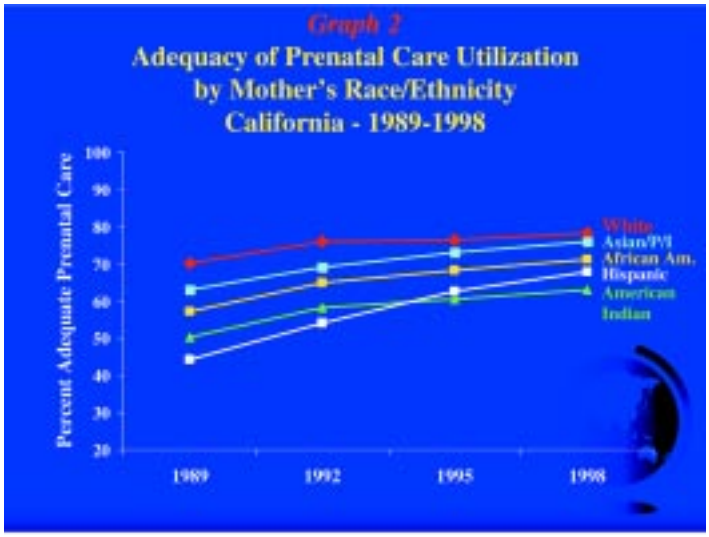
Factors that can put a mother at risk for inadequate prenatal care include such maternal characteristics as poverty, single marital status, low-level of education, non-metropolitan residence,[26] and cultural barriers.[27] Institutional characteristics can also play a role in the utilization of prenatal care services. Studies suggest that the mother's health care plan,[28] the adequacy of the health care delivery system,[29] and changes in public health funding[30] can impact the mother's ability to receive adequate prenatal care.

How Do We Measure It?

For this report prenatal care utilization will be measured by the Adequacy of Prenatal Care Utilization (APNCU) index. The APNCU is a comprehensive measure of prenatal care utilization that analyzes the mother's timing of initiation of prenatal care, and the number of prenatal care visits compared to those recommended by the American College of Obstetricians and Gynecologists (for a further explanation, see the Methods and Results section). Inadequate prenatal care utilization, as measured by the APNCU, has been associated with an increased risk of low birthweight.[31]

The History of Adequacy of Prenatal Care Utilization in California

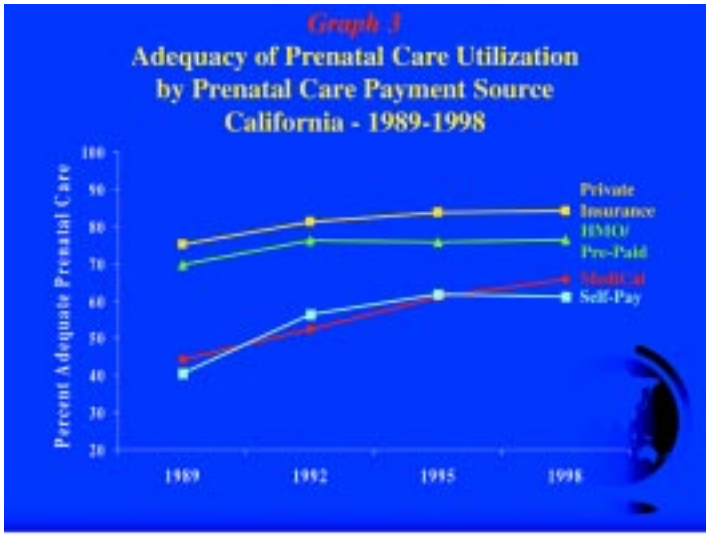
Over the 1989 to 1998 period, there have been important changes in the adequacy of prenatal care utilization among women in California. In 1989, as measured by the APNCU, mothers received adequate prenatal care in only 58.7% of all birth (Graph 1). By 1990, California had increased its' MediCal coverage of prenatal care through Medicaid options and the use of state-based funding



to expand eligibility for women who did not have private insurance. These changes have led to steady improvements in adequate prenatal care utilization in California. However, by 1998, as the effect of these improvements have begun to level off, California women received adequate prenatal care in only 72.5% of all births.

Over this period of time (1989-1998) several trends are apparent in the adequacy of prenatal care utilization among race/ethnic subgroups (Graph 2). The most striking trend is the considerable improvements among Hispanic mothers. Adequate prenatal care utilization for these mothers increased from 44.2% in 1989 to 67.8% in 1998, the largest improvement in the percent of adequate care among any of the race/ethnic subgroups.

Focusing on gaps between race/ethnic subgroups (a gap is defined here as the absolute difference in the percent of adequate prenatal care utilization in one subgroup compared to another), the gap in percents of adequate prenatal care when comparing Whites (the highest group) and Hispanics (the lowest group) narrowed from 26.0% in 1989 to just 10.5% in 1998. Furthermore, when compared to Whites, the prenatal care utilization gap narrowed for Asian (7.2% in 1989 to 2.4% in 1998), African American (13.1% in 1989 to 7.2% in 1998), and American Indian mothers (19.9% in 1989 to 15.3% in 1998).



Those mothers who received their prenatal care through MediCal had the most improvement in their prenatal care utilization over the 1989 to 1998 time period (Graph 3). Both MediCal and Self Pay sources of prenatal care payment saw considerable improvement in prenatal care utilization between 1989 (44.1% and 40.5% respectively) and 1995 (60.9% and 61.8% respectively), however, while MediCal continued its upward improvement in 1998 (65.8%), the Self Pay source of payment remained virtually the same (61.2%). Similarly, mothers who paid for pre-

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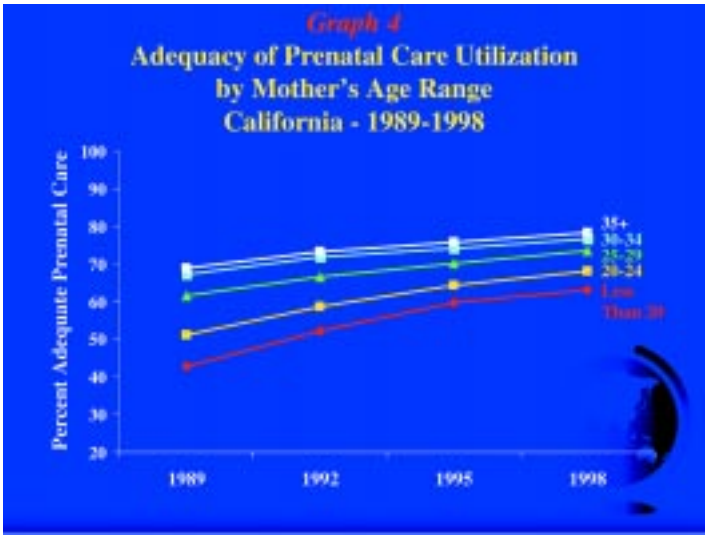
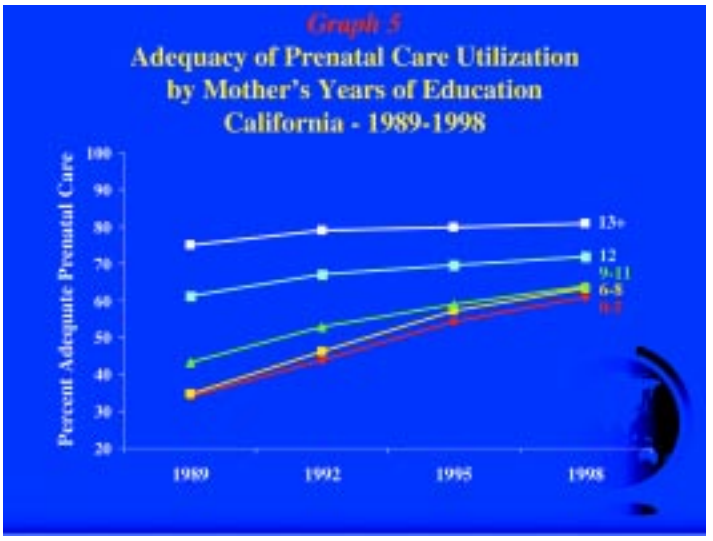
natal care through Private Insurance saw almost no improvements between 1995 (83.7%) and 1998 (84.1%). Mothers who paid for prenatal care through HMO/Pre-Paid plans saw no improvement in prenatal care utilization between 1992 (76.2%) and 1998 (76.3%). Nevertheless the gap between the MediCal and Private Insurance payment sources was reduced between 1989 (31.0%) and 1998 (18.3%).



Improving trends in prenatal care utilization are also apparent by the mother's age (Graph 4). Generally, the older the mother the more likely it was that she would receive adequate prenatal care. Teenagers consistently received the least adequate prenatal care of all age ranges. However, between 1989 and 1998, when compared to the oldest mothers, the youngest mothers narrowed the gap.

Finally, these improving trends in prenatal care utilization extend to the mother's education (Graph 5). Generally, the more educated the mother the more likely it was that she would receive adequate prenatal care. Mothers with less than a high school education consistently received the least adequate prenatal care. However, the gap among the least educated mothers (0-5, 6-8, and 9-11 years of education) nearly disappeared between 1989 and 1998. During this same time period, when compared to the college educated mothers, these less educated mothers narrowed the gap considerably.

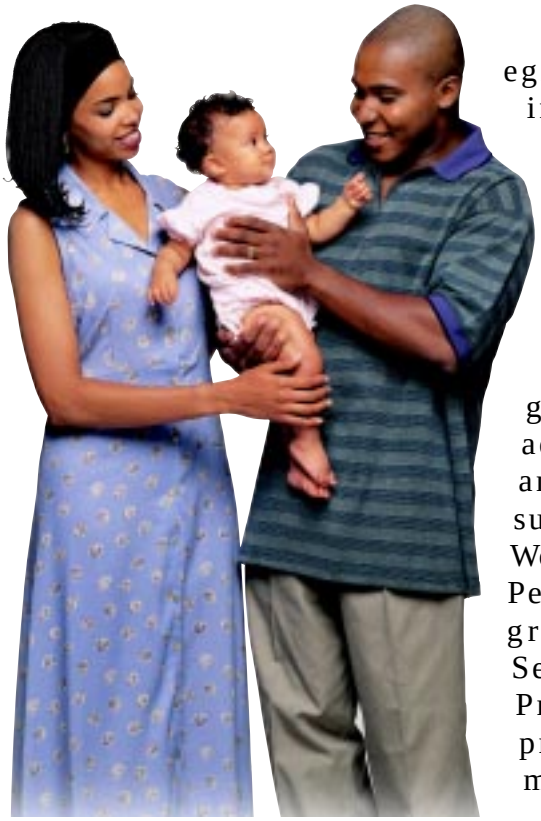


The Local Picture

While California had a 13.8% improvement in the absolute difference in the percent of adequate prenatal care utilization between 1989 and 1998 (see Appendix - Table 1), there were important variations across counties. All but seven of the 56 counties for which a calculation could be made had an increase in the percent of adequate prenatal care utilization. Although Sierra County had the largest improvement in the percent of prenatal care utilization (37.7%), the actual number of births was small. Among the most substantial improvements in both the percent and number of adequate prenatal care births were those in Tulare, Fresno, Orange, Los Angeles, Riverside, San Mateo and Ventura counties.

Although gains in prenatal care utilization in the last decade have been impressive across maternal race/ethnic groups, age ranges, education levels, pay source systems, and local health jurisdictions, significant gaps in specific subgroups continue to exist. The national objective for the year 2010 recommends that inadequate prenatal care be reduced to 10% of all births.[32] Since 27.5% of the births in California during 1998 were to mothers with inadequate prenatal care, there continues to be a significant public health challenge that must be met through innovation and improved strategies.

Strategies for Further Improvements



As discussed above, several strategies have been used statewide to improve prenatal care utilization. Among these, was the expansion of MediCal eligibility criteria, improved access to MediCal through presumptive and continuous eligibility, a waived assets test, and reduced application paperwork.

Currently, several state programs support improvements in adequate prenatal care through direct and indirect delivery of services and support. These programs include the Women, Infants, and Children Program, Perinatal Outreach and Education Program, Comprehensive Perinatal Services Program, Black Infant Health Program, and BabyCal Program. These programs often utilize individual case management that increases outreach

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and case finding, and helps to identify the geographic regions at highest risk for inadequate prenatal care.

However, since these alternatives can be expensive, and California is a large state with a diverse population, the need to systematically focus on targeted areas has become an important objective. Small Area Analysis within a county using Geographic Information Systems (GIS) has become a prominent tool in the cost-effective targeting of sub-county areas of high need. The ability to determine the geographic relationship between problem areas and service delivery sites provides an enhanced way to assess problems and more precisely deliver programmatic responses. The more specific the targeting to problem areas and populations, the better the potential programmatic success.

The current mapping study objectives were to locate "hot spots" throughout the state at the census tract level where inadequate prenatal care utilization rates were statistically significantly higher than the statewide rate. To allow for better interpretation of hot spot problems, we also placed the residences of the mothers who received inadequate prenatal care to within one mile of the actual location (a process called "masking" that is used for purposes of confidentiality). Statewide maps were then created showing the relationship between these two variables as well as the location of birthing hospitals throughout the state.

The following maps will be shared with state and local agencies involved in improving prenatal care utilization and should be very useful in directing programmatic outreach activities. Local communities may use the maps to target efforts to improve utilization of prenatal care as well as to monitor trends over time. This publication will also be available at the California Department of Health Services' web site for view by the general public.

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The Maps

What They Tell Us

The following maps give significant detail about the prevalence of prenatal care utilization throughout the entire state. Out of 5,858 census tracts in California, 659 (11.2%) were identified as "hot spots" with a statistically significantly higher percent of inadequate prenatal care births than the state as a whole. 4,044 (69%) census tracts were not statistically significantly higher. Of these, 2,531 (43.2%) census tracts had a percent of inadequate prenatal care that was either at or below the state as a whole. 1,155 (19.7%) census tracts had fewer than five births; too few for a reliable calculation of the percent of inadequate prenatal care.

In viewing the maps it is important to note that large census tracts are invariably located in regions of sparse population. Consequently a single large census tract hot spot will have few births, although its size may make it appear to be more important than a small hot spot. In these maps, the geographic size of the hot spot is not related to the importance of the hot spot. Clusters of geographically large hot spots in more rural areas can be seen throughout the state. These include all of San Benito county and much of Butte, Imperial, Mendocino, Merced, Riverside, Stanislaus, and Yuba counties. Large regions of California have no births, because there are small or non-existent populations.

As would be expected, small hot spots with large numbers of inadequate prenatal care births are heavily clustered in major population centers. The largest of these are the southeast Los Angeles-northwest Orange region, west Riverside region, and southwest San Bernardino region. Other heavily populated clusters of smaller hot spots are located in the west, south and east San Francisco bay region, west San Diego region, and scattered areas throughout the central valley.

Inadequate prenatal care is more prevalent among populations of lower socio-economic status.[26] This is confirmed both in the above analysis of payment source for prenatal care and in the ensuing maps. For example, within Los Angeles County, around the well-populated, higher income areas of Santa Monica and West Hollywood there are large areas of contiguous census tracts that have fewer than five inadequate prenatal care births. In contrast, the well-populated, lower income areas near Jefferson, Florence and South Gate have large areas of contiguous hot spots. These and other markers for inadequate prenatal care will be evident to those most familiar with local conditions.

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How to Read the Maps

Double Black lines are freeways or highways.

Thin black lines are census tract boundaries.

Blue lines are county boundaries.

Red census tracts have percents of *inadequate* prenatal care utilization that are statistically significantly higher than the statewide rate.

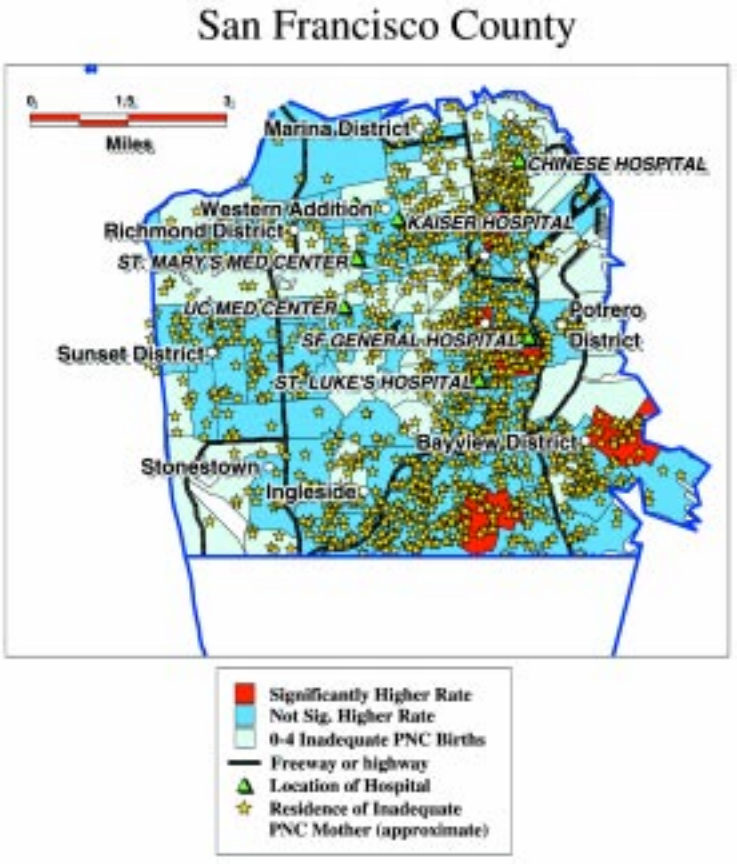
Dark blue census tracts have percents of *inadequate* prenatal care utilization that are statistically less than or equal to the statewide rate.

Light blue census tracts have too few inadequate prenatal care births to calculate a reliable small area estimate.

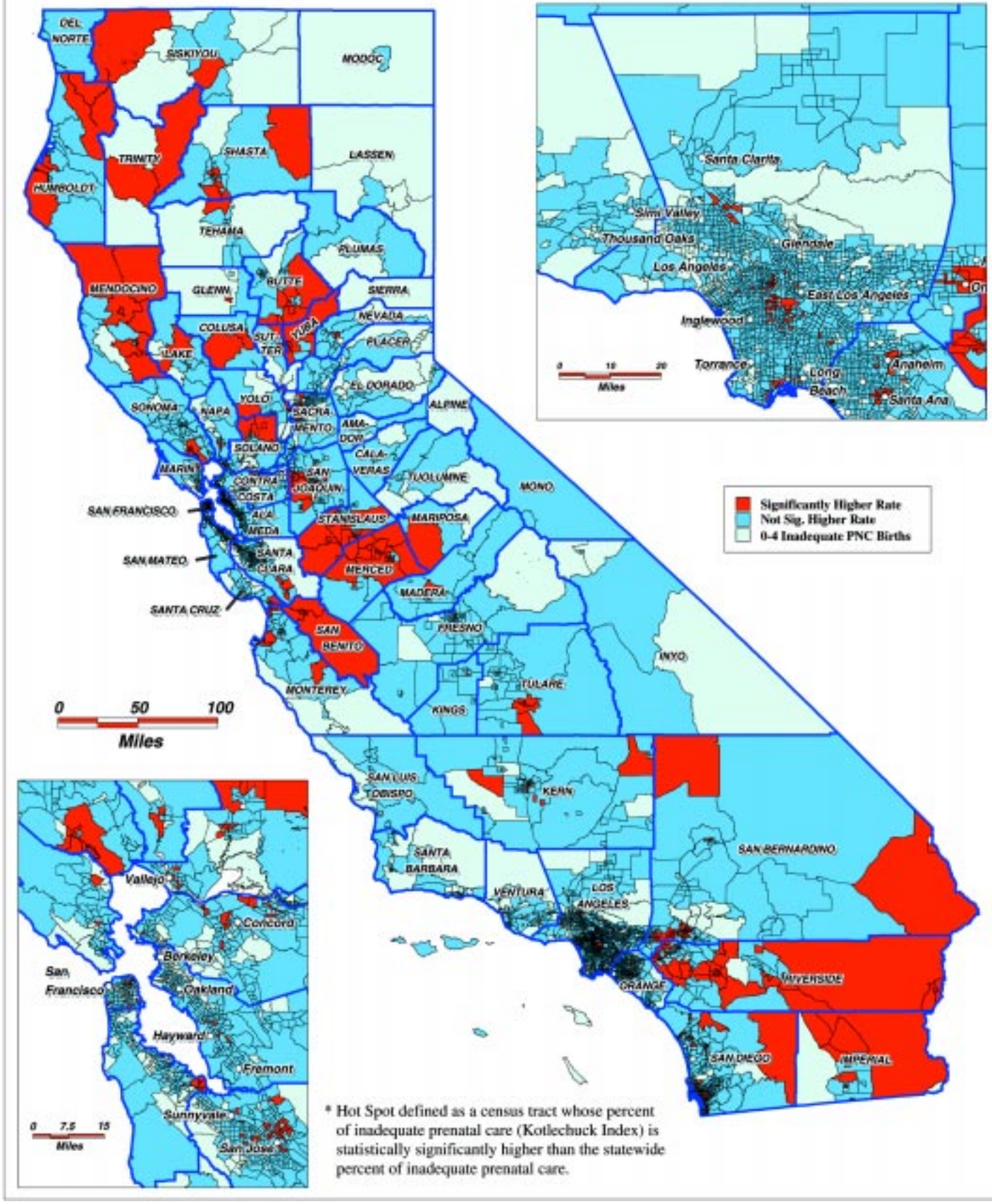
Stars are the residences of mothers with inadequate prenatal care. These stars are placed within one mile of the actual location to preserve confidentiality.

Green triangles are the location of a birthing hospital.

PNC is an abbreviation for prenatal care.

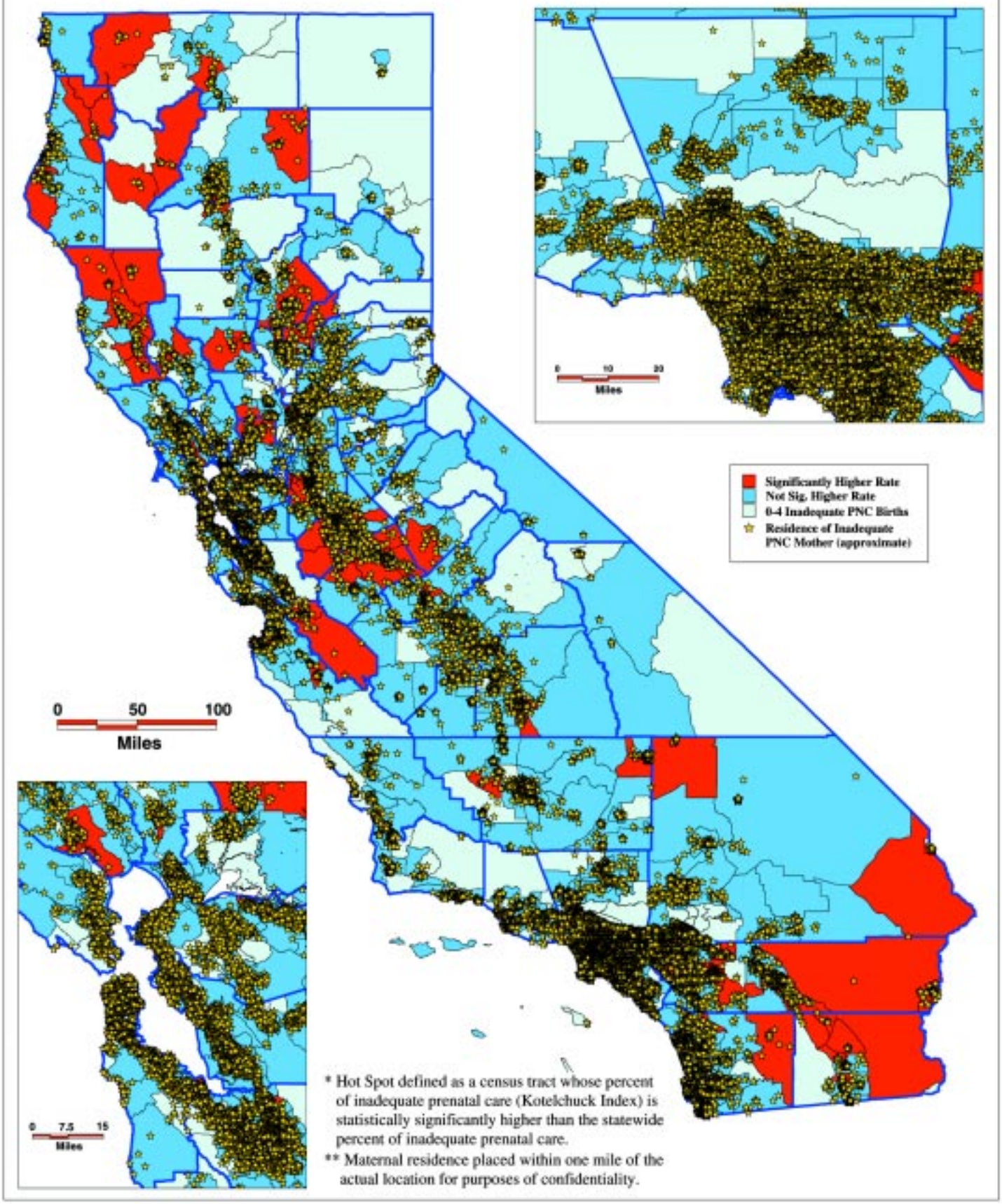


Inadequate Prenatal Care Hot Spots*
at the Census Tract Level, California - 1998



* Hot Spot defined as a census tract whose percent of inadequate prenatal care (Kotlechuck Index) is statistically significantly higher than the statewide percent of inadequate prenatal care.

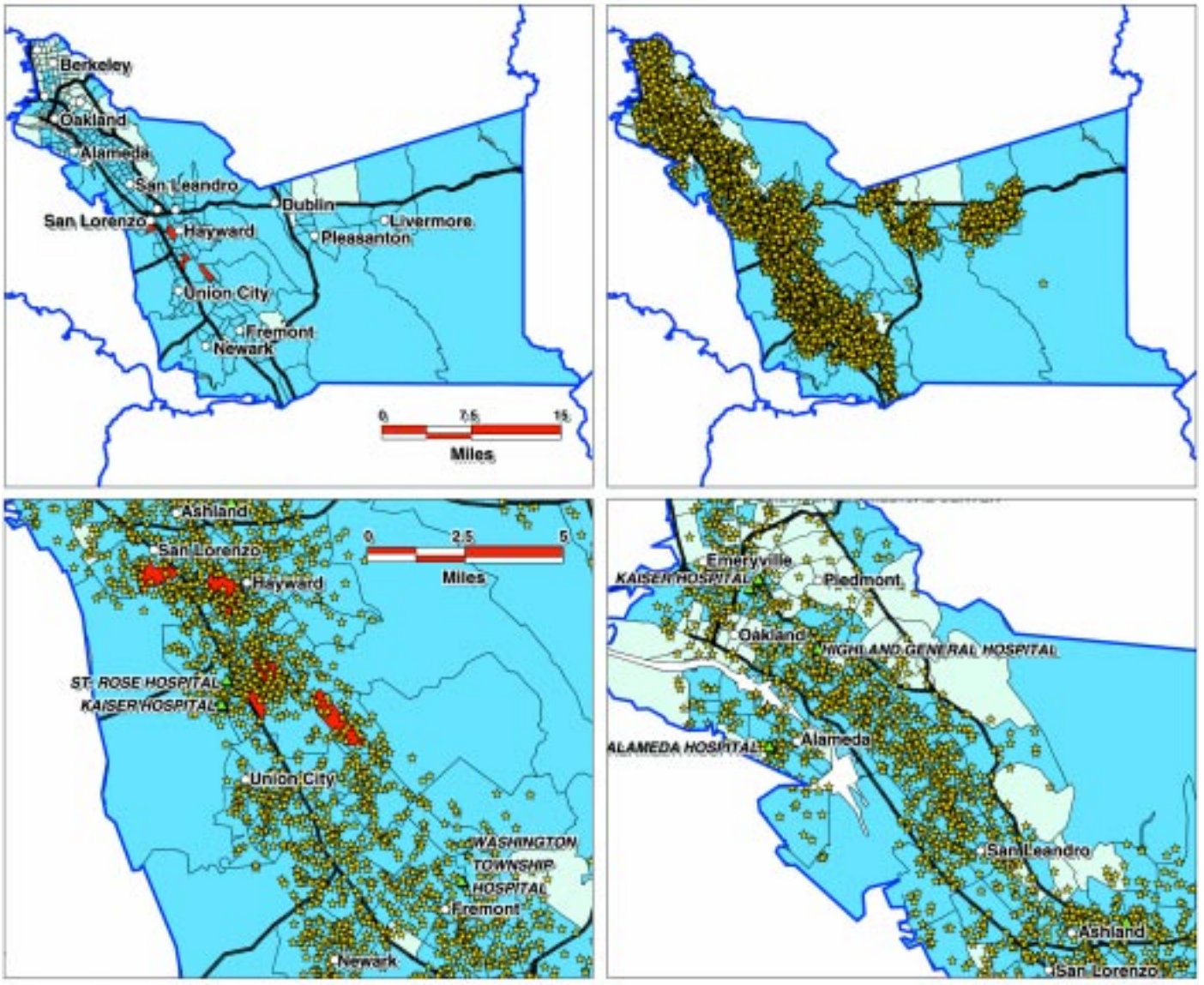
Inadequate Prenatal Care Hot Spots* with Maternal Residences** at the Census Tract Level, California - 1998



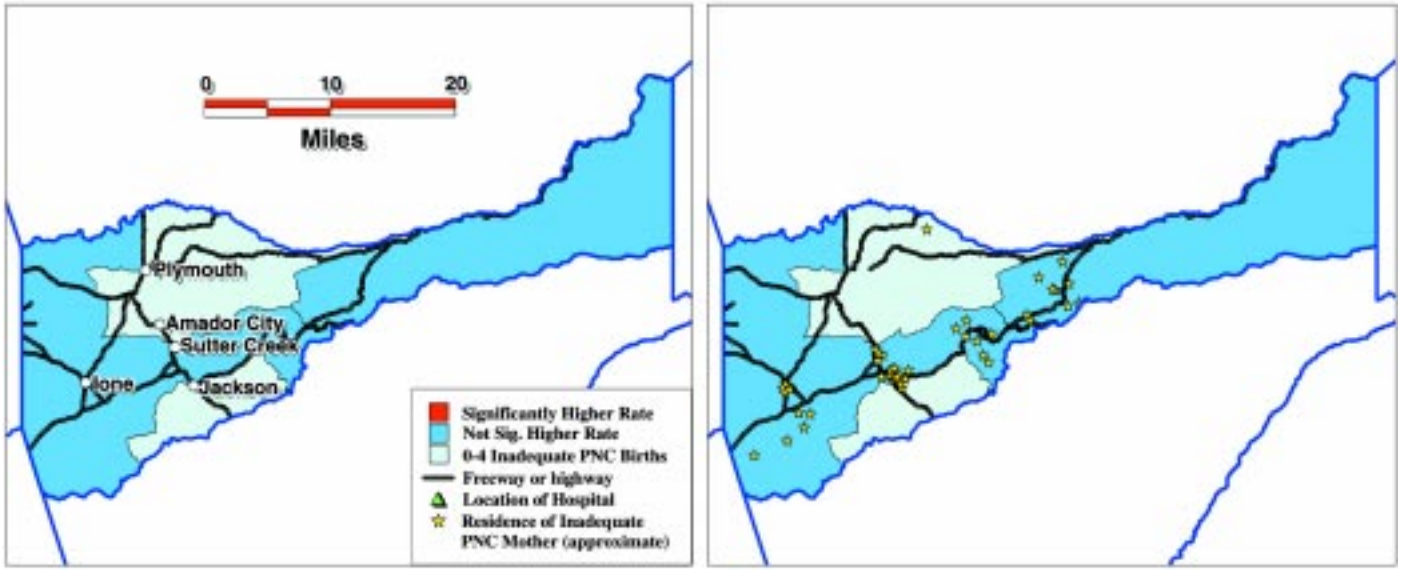
* Hot Spot defined as a census tract whose percent of inadequate prenatal care (Kotelchuck Index) is statistically significantly higher than the statewide percent of inadequate prenatal care.

** Maternal residence placed within one mile of the actual location for purposes of confidentiality.

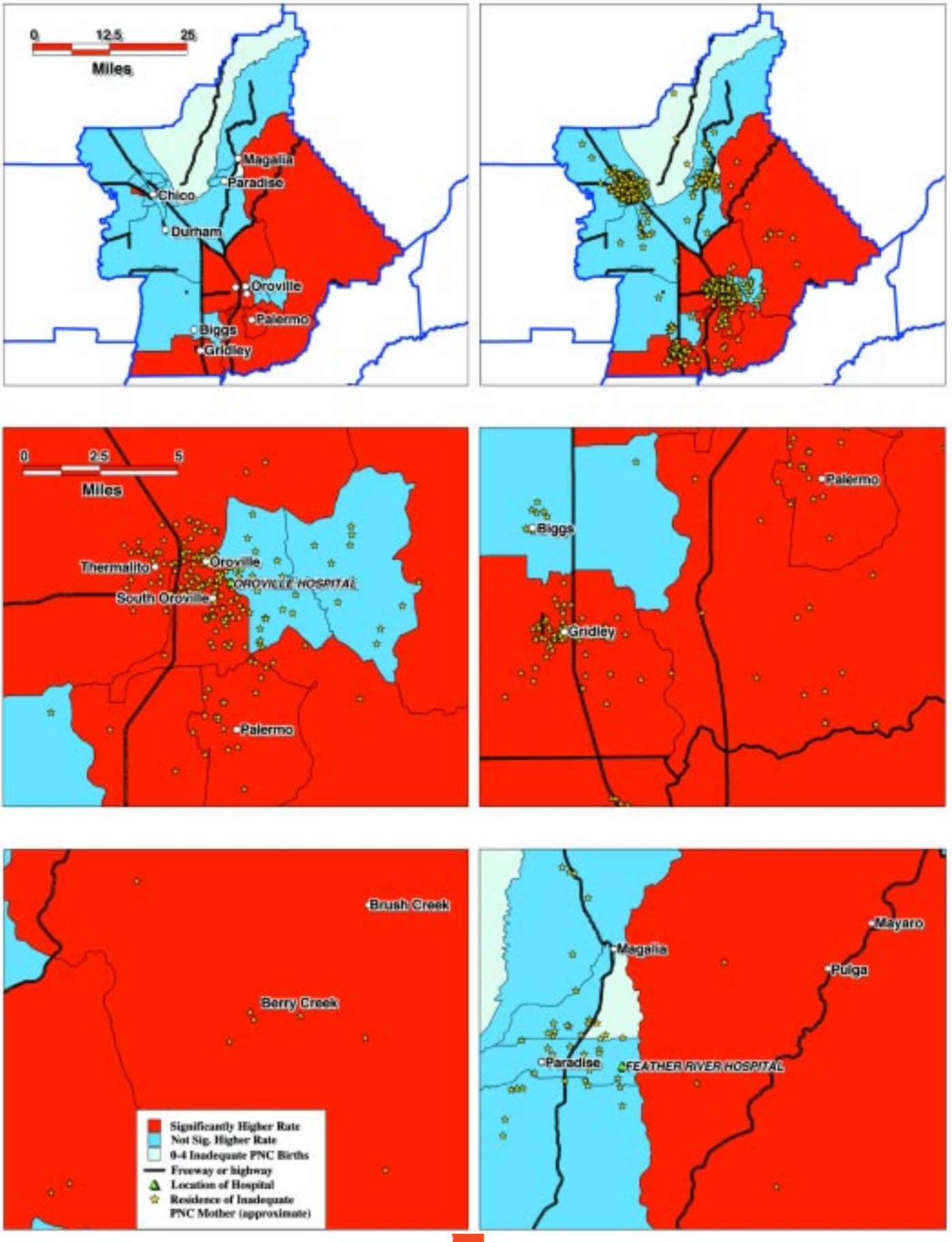
Alameda County



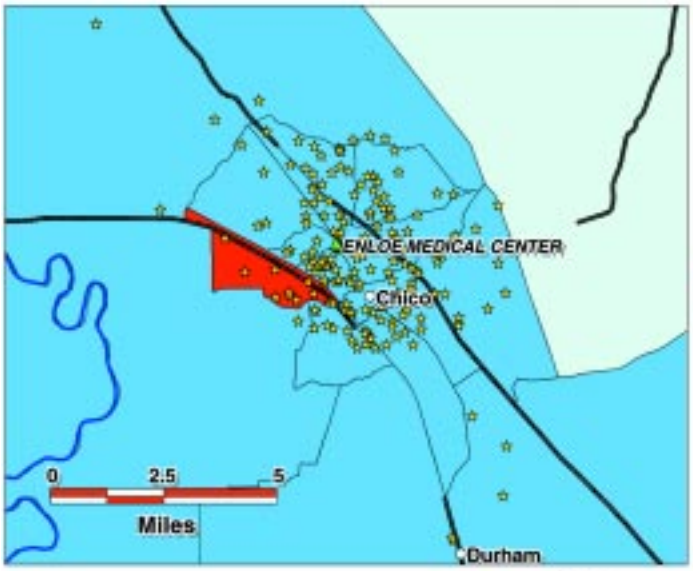
Amador County

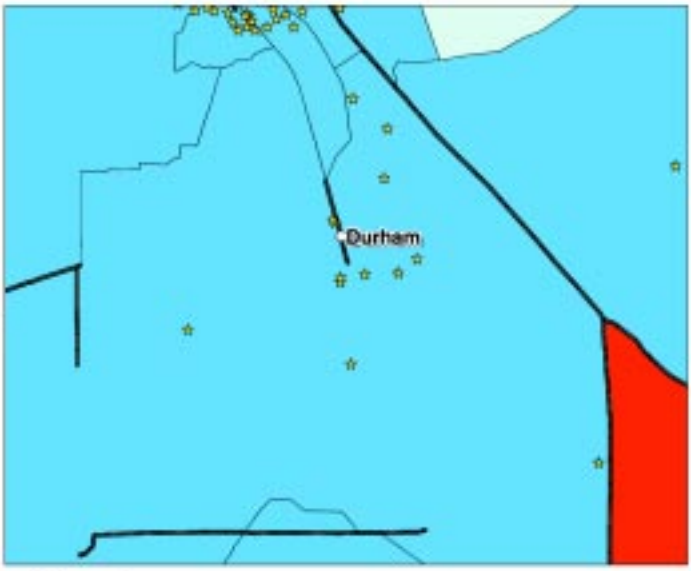


Butte County

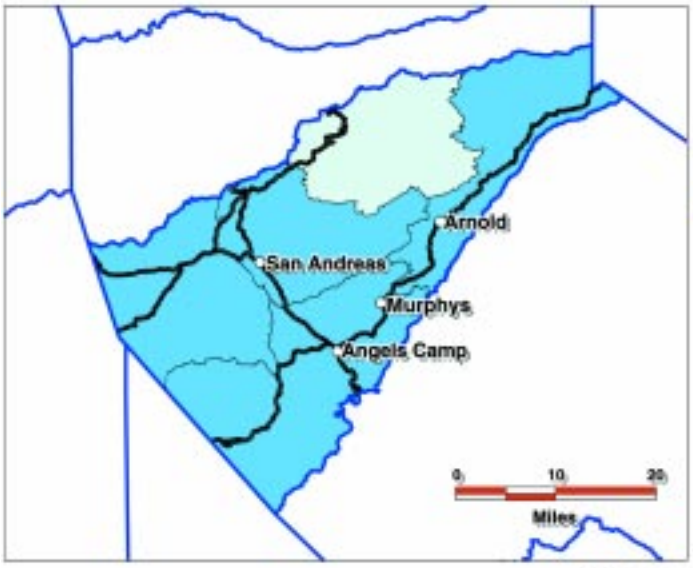


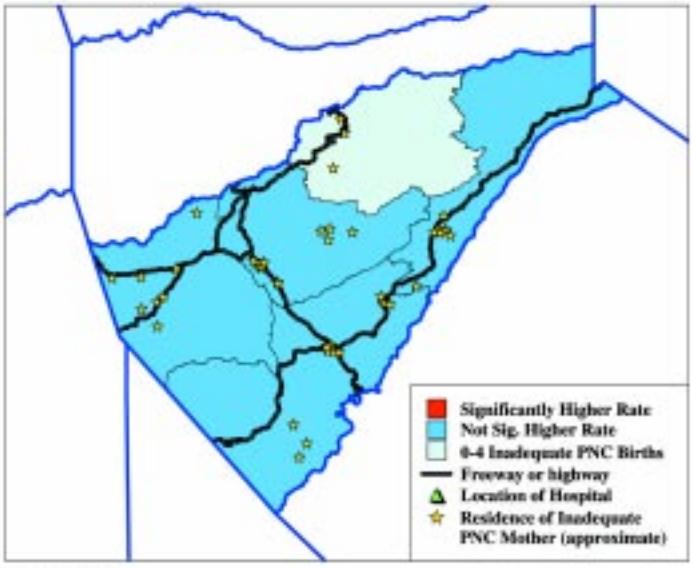
Butte County (cont.)



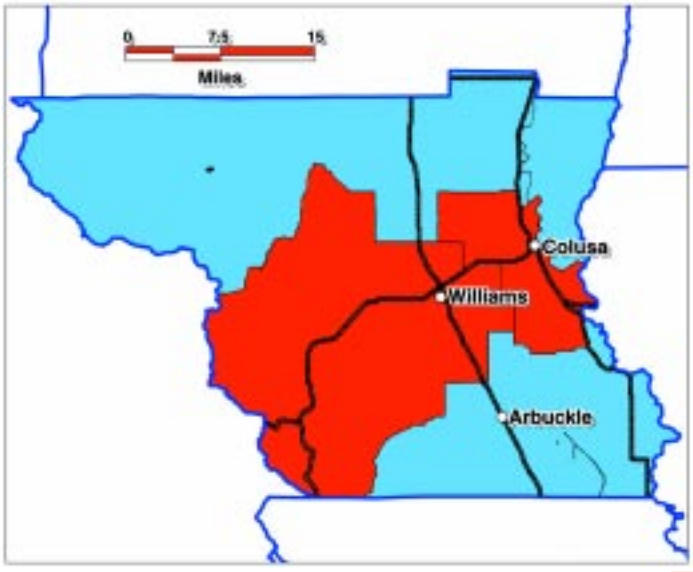


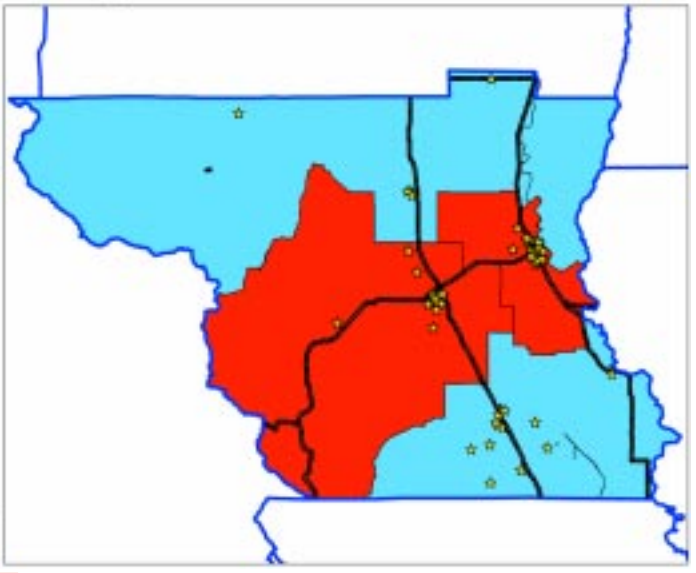
Calaveras County





Colusa County





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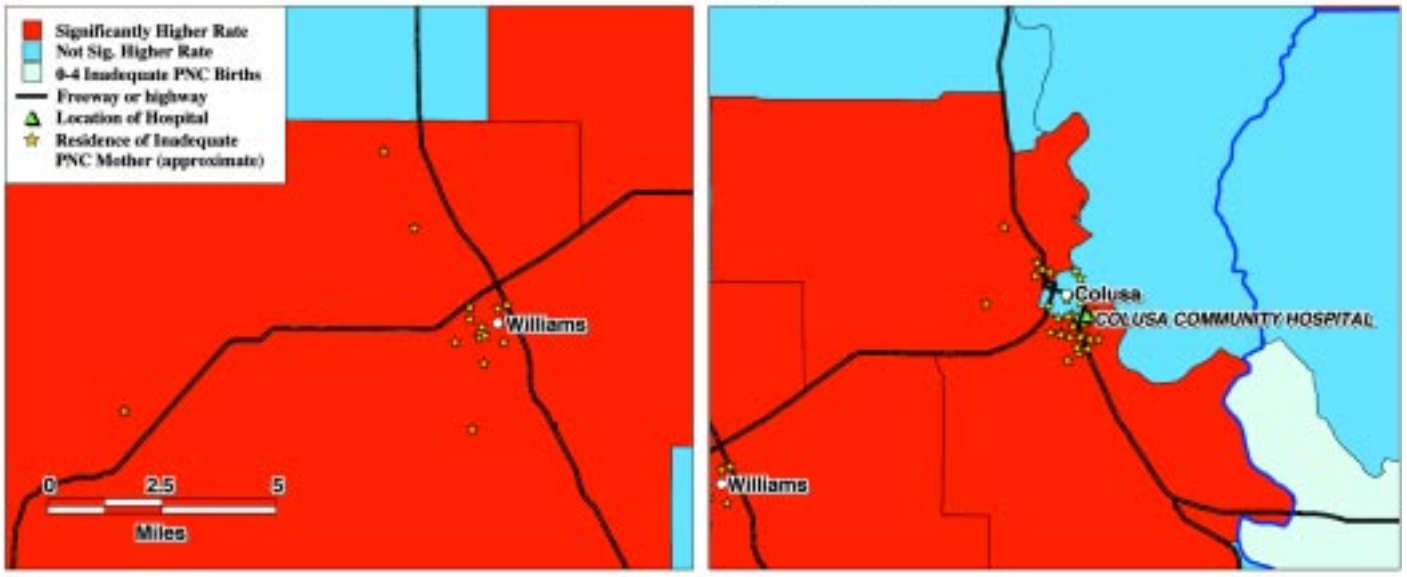
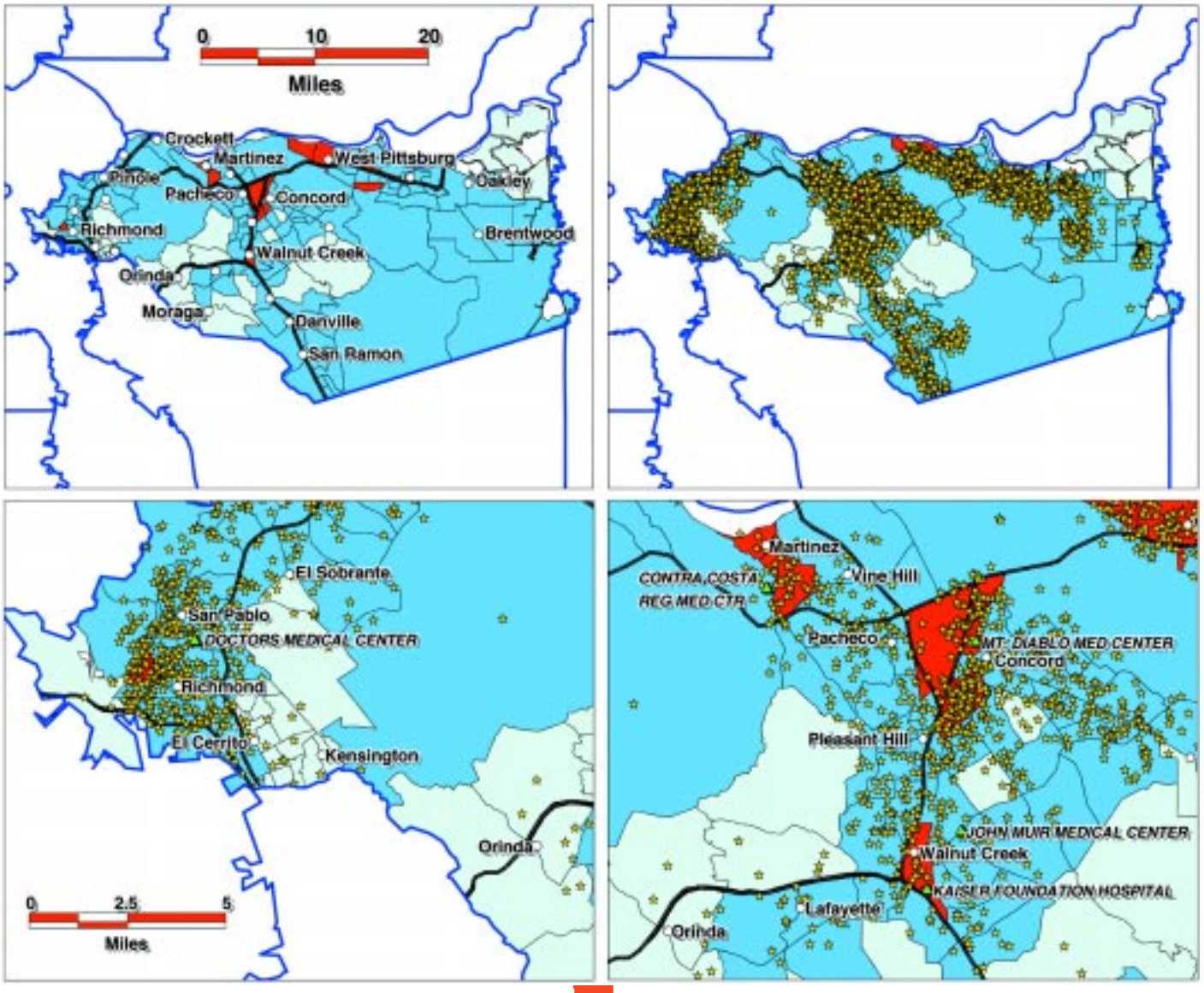
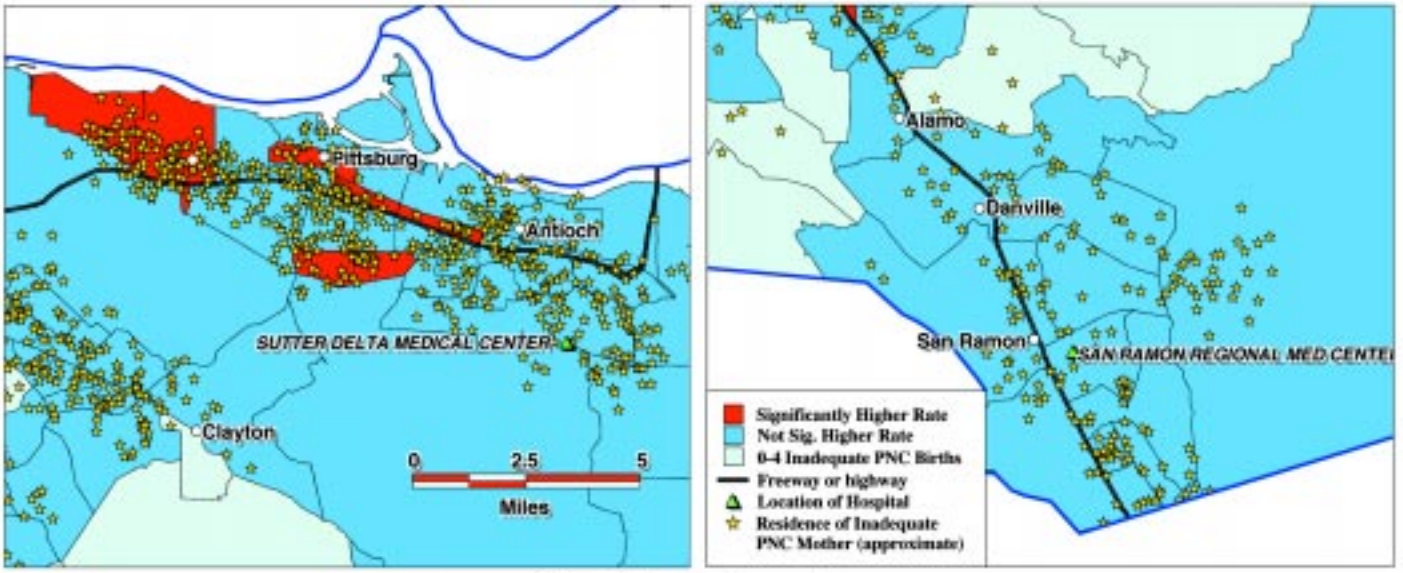


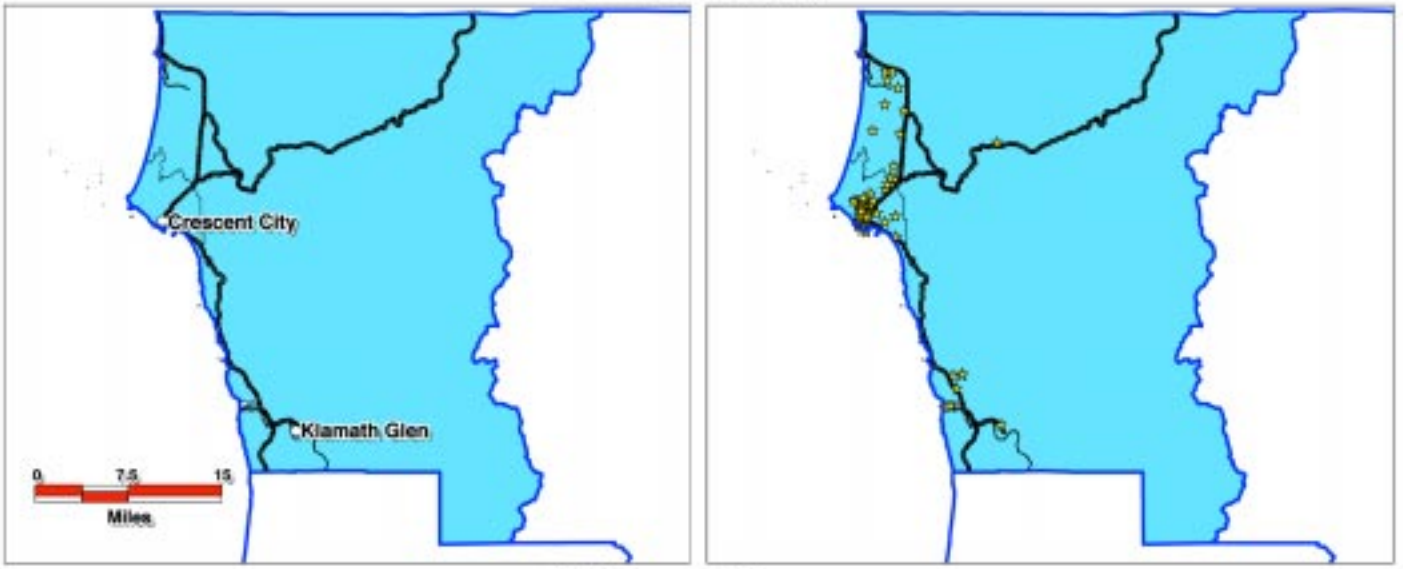
Contra Costa County



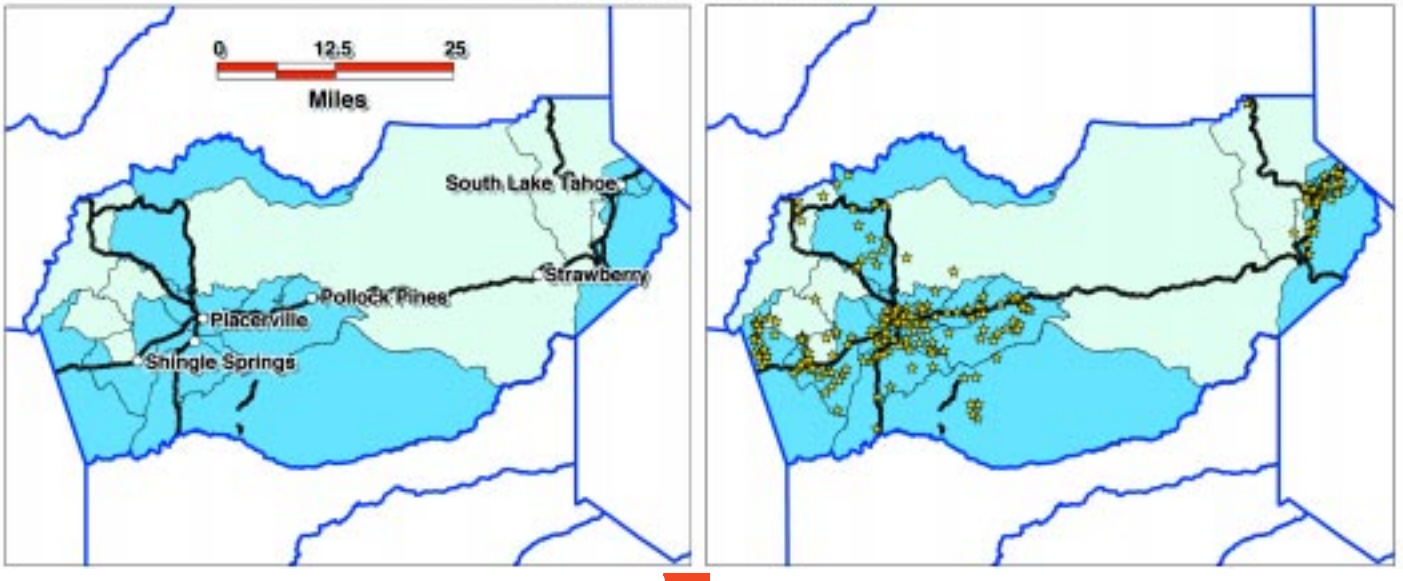
Contra Costa County (cont.)



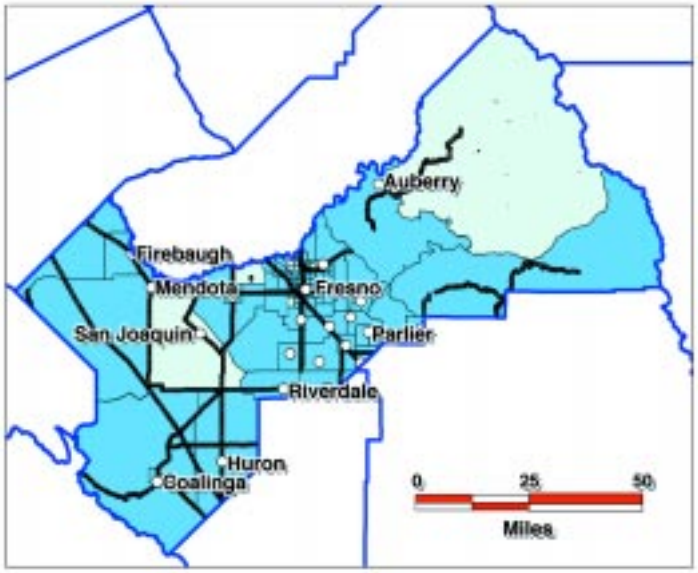
Del Norte County

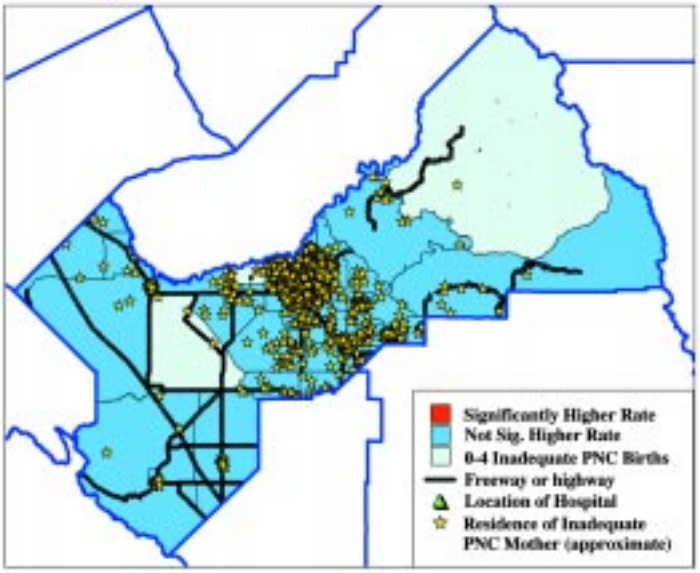


El Dorado County

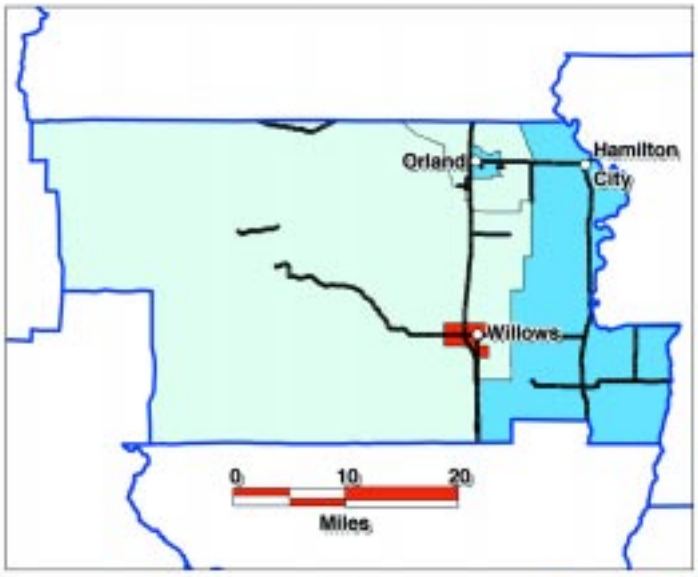


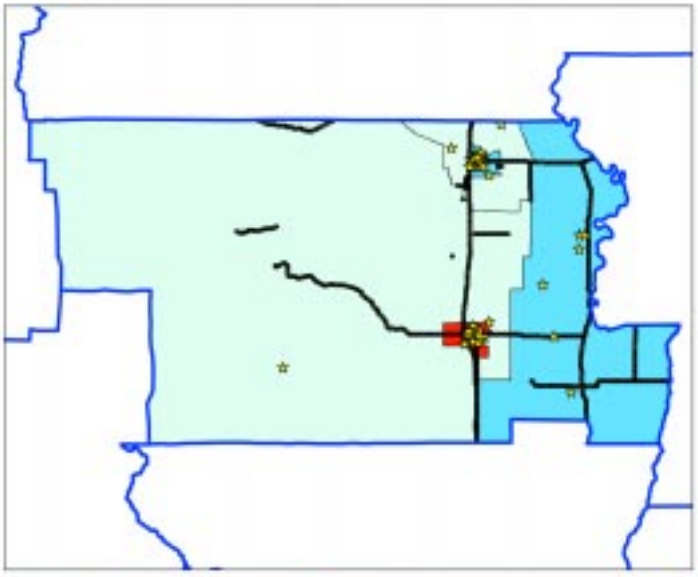
Fresno County

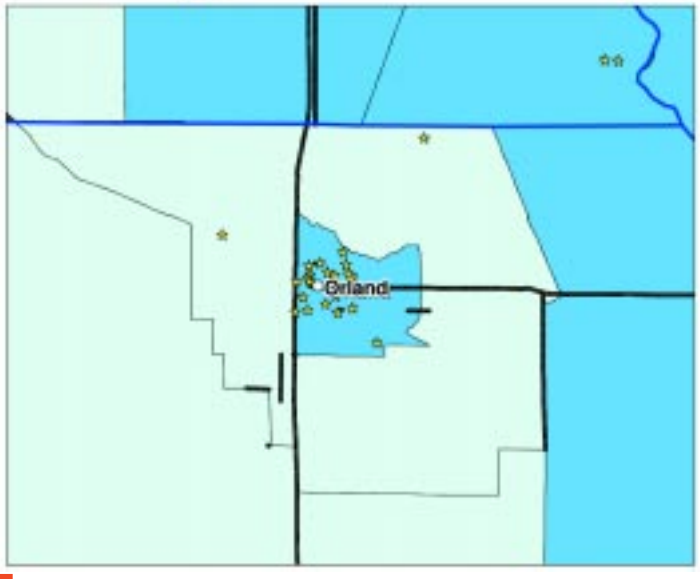




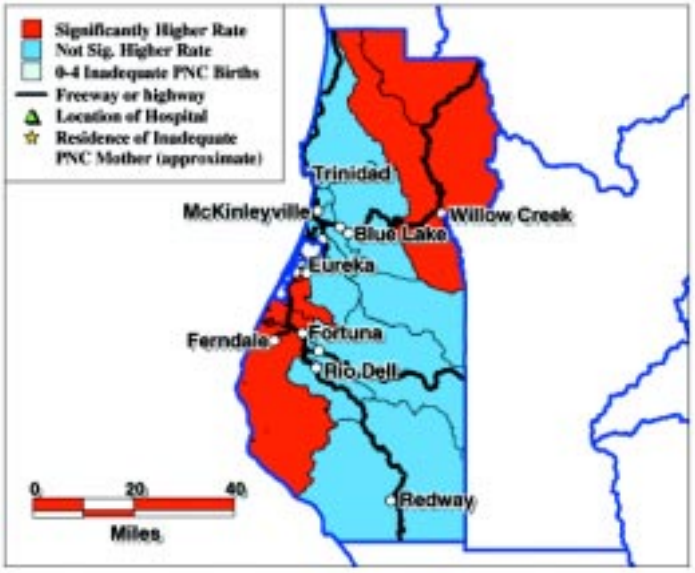
Glenn County

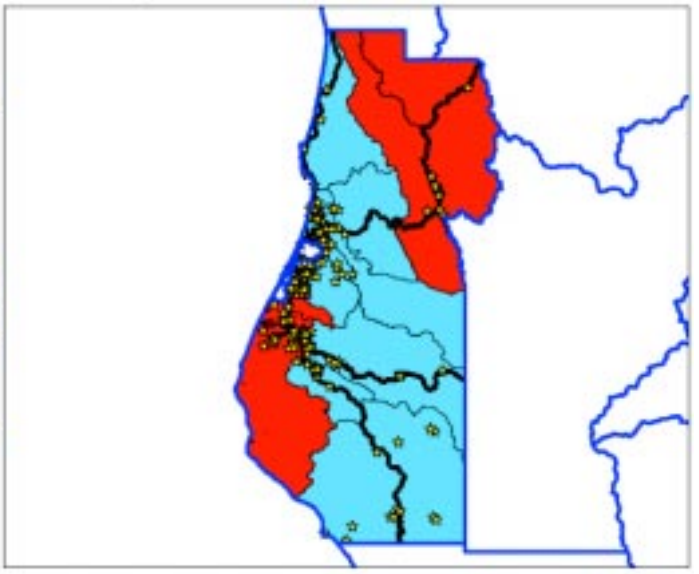


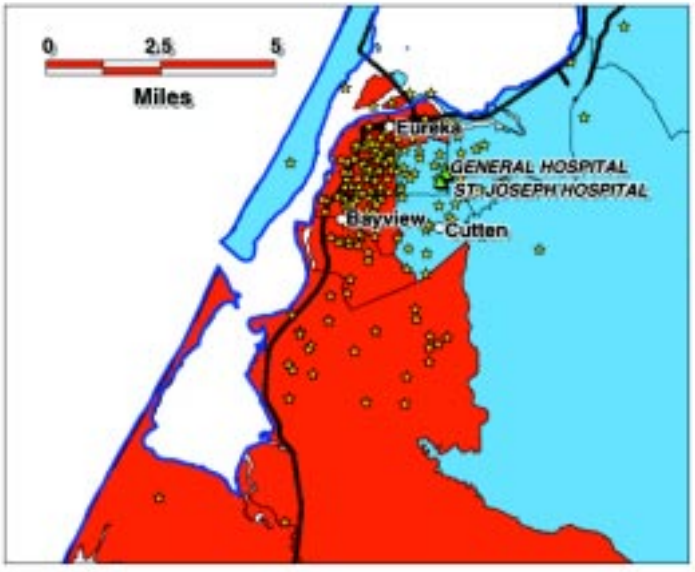




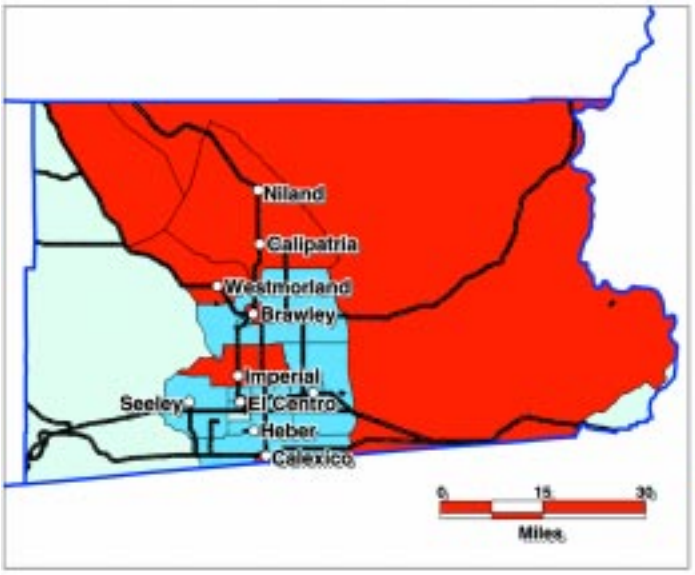
Humboldt County

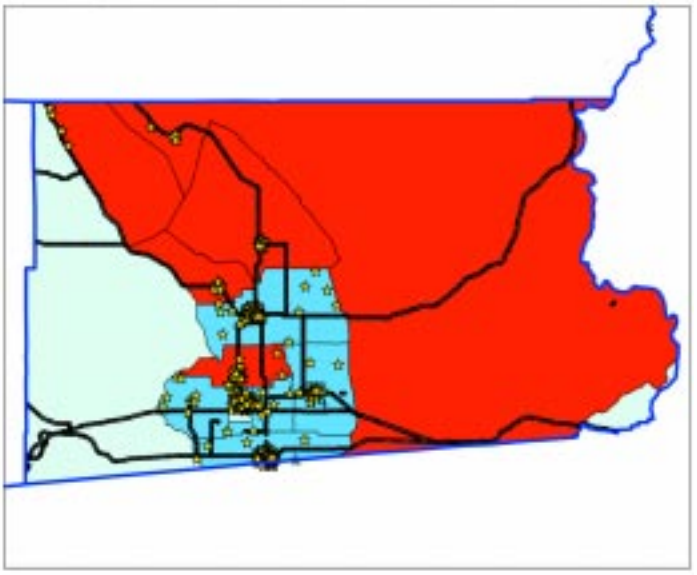


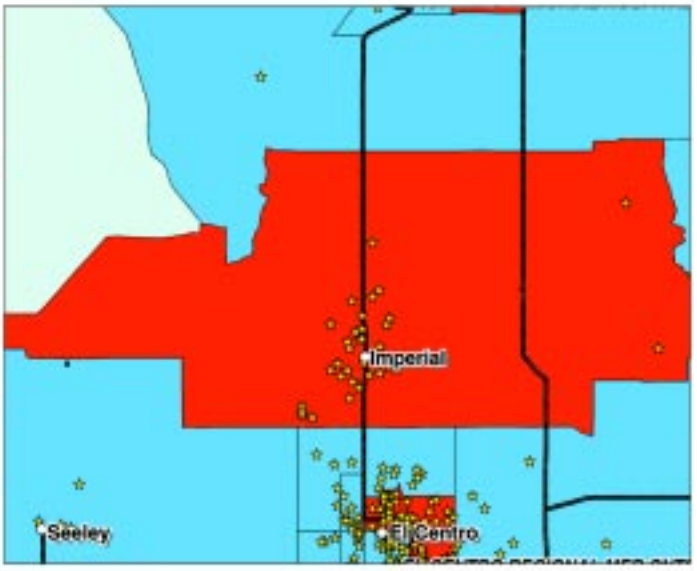


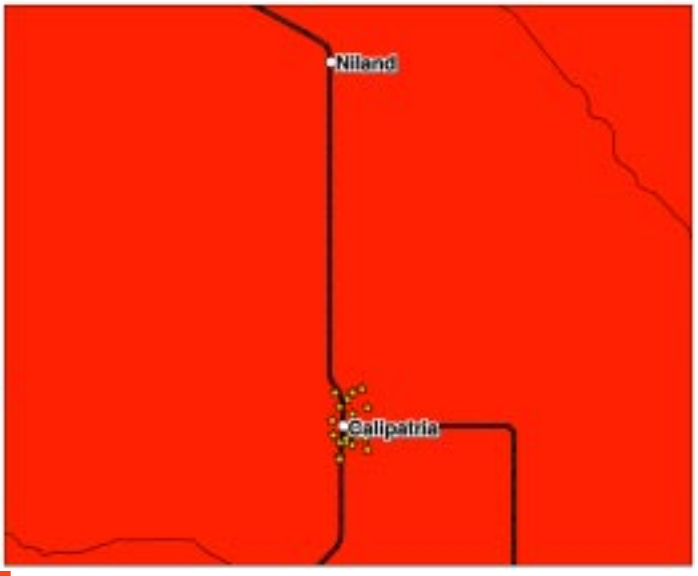


Imperial County









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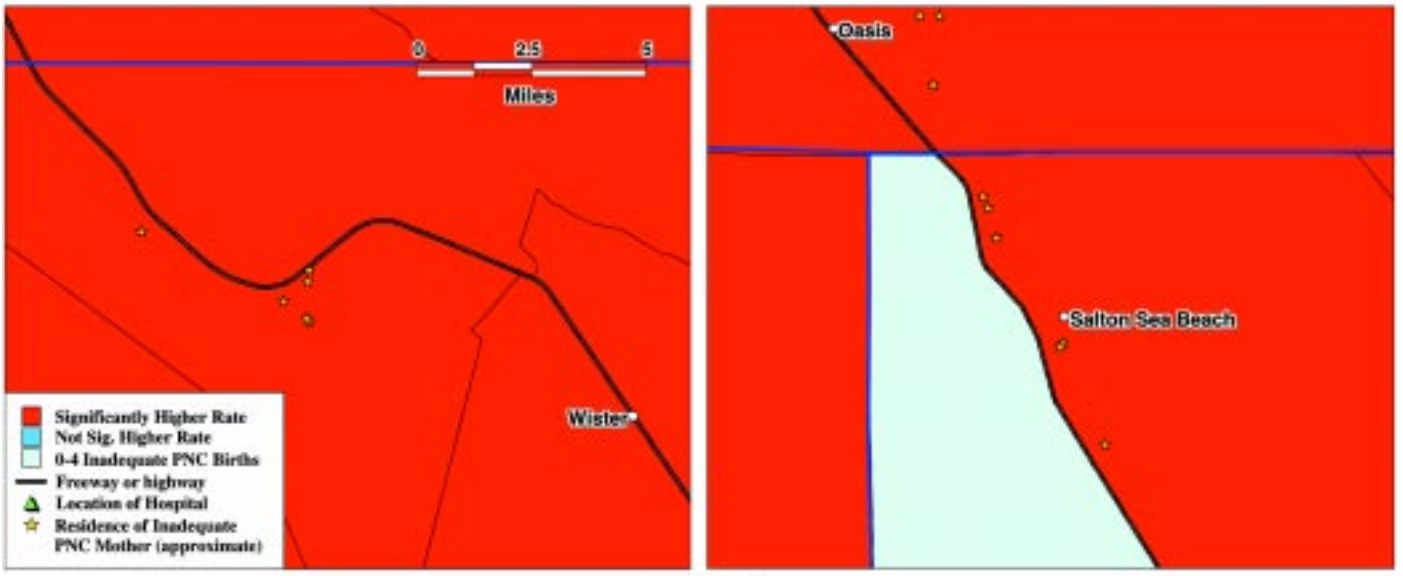
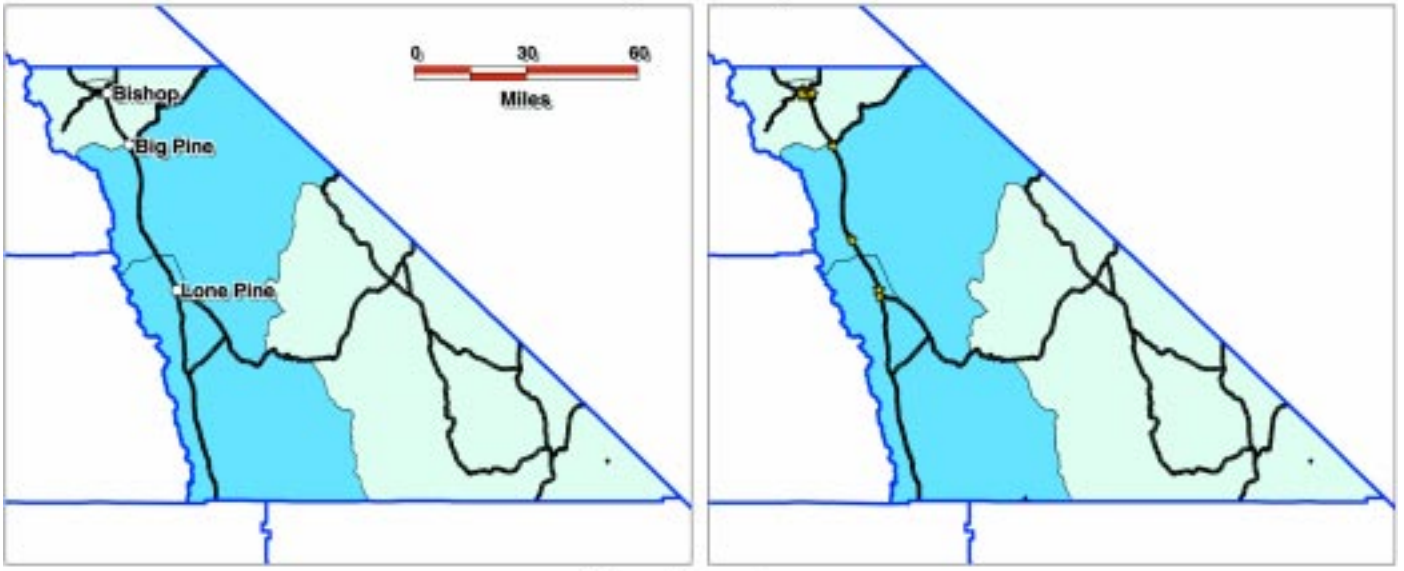
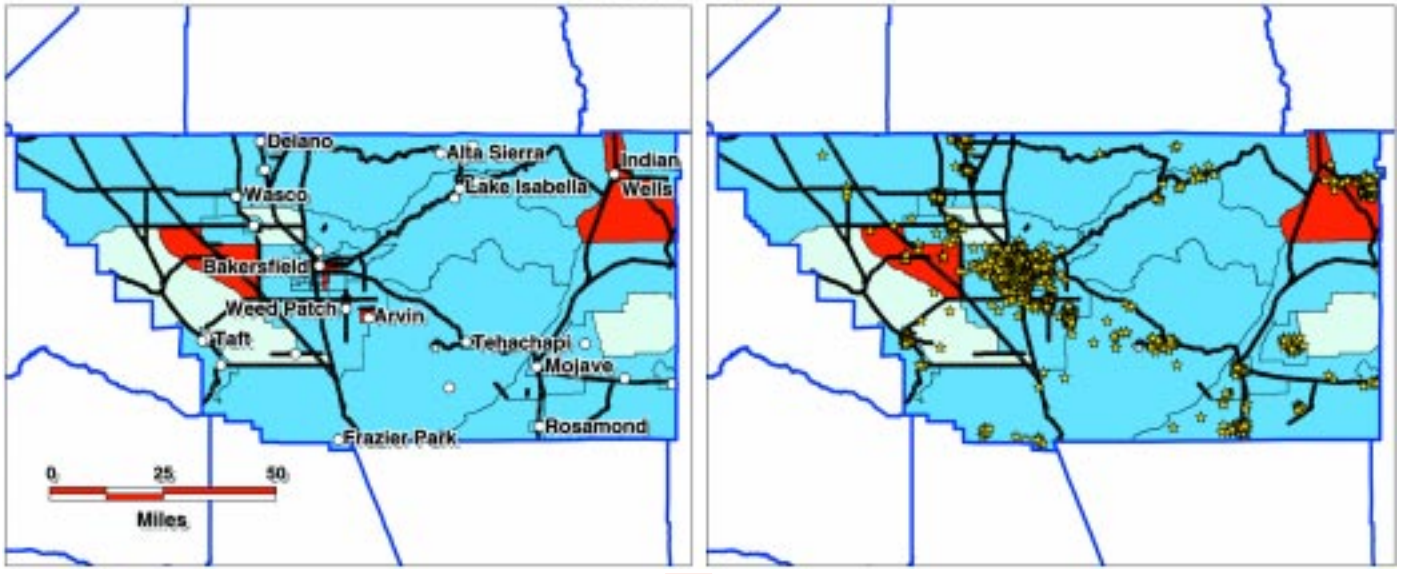


Inyo County



Kern County



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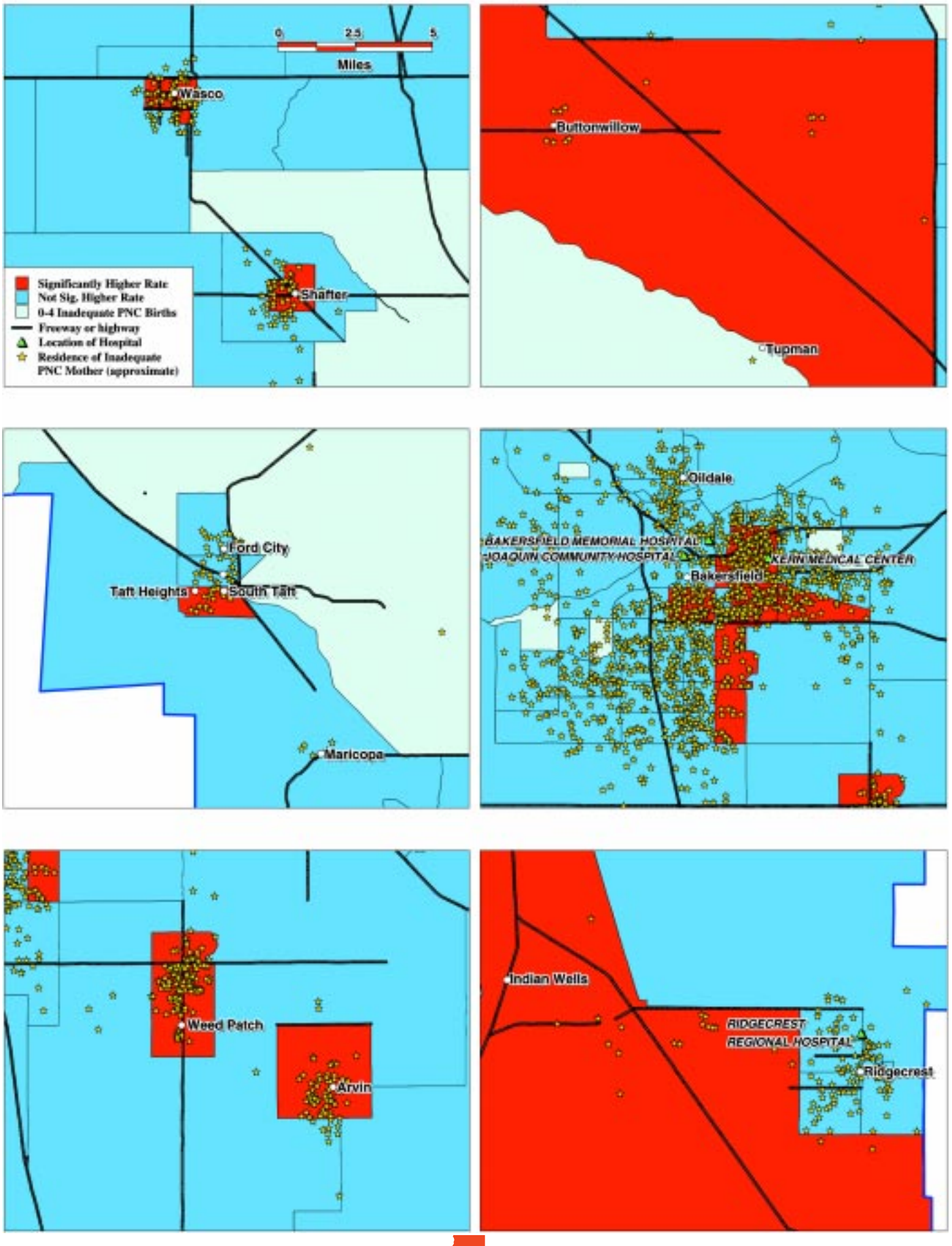
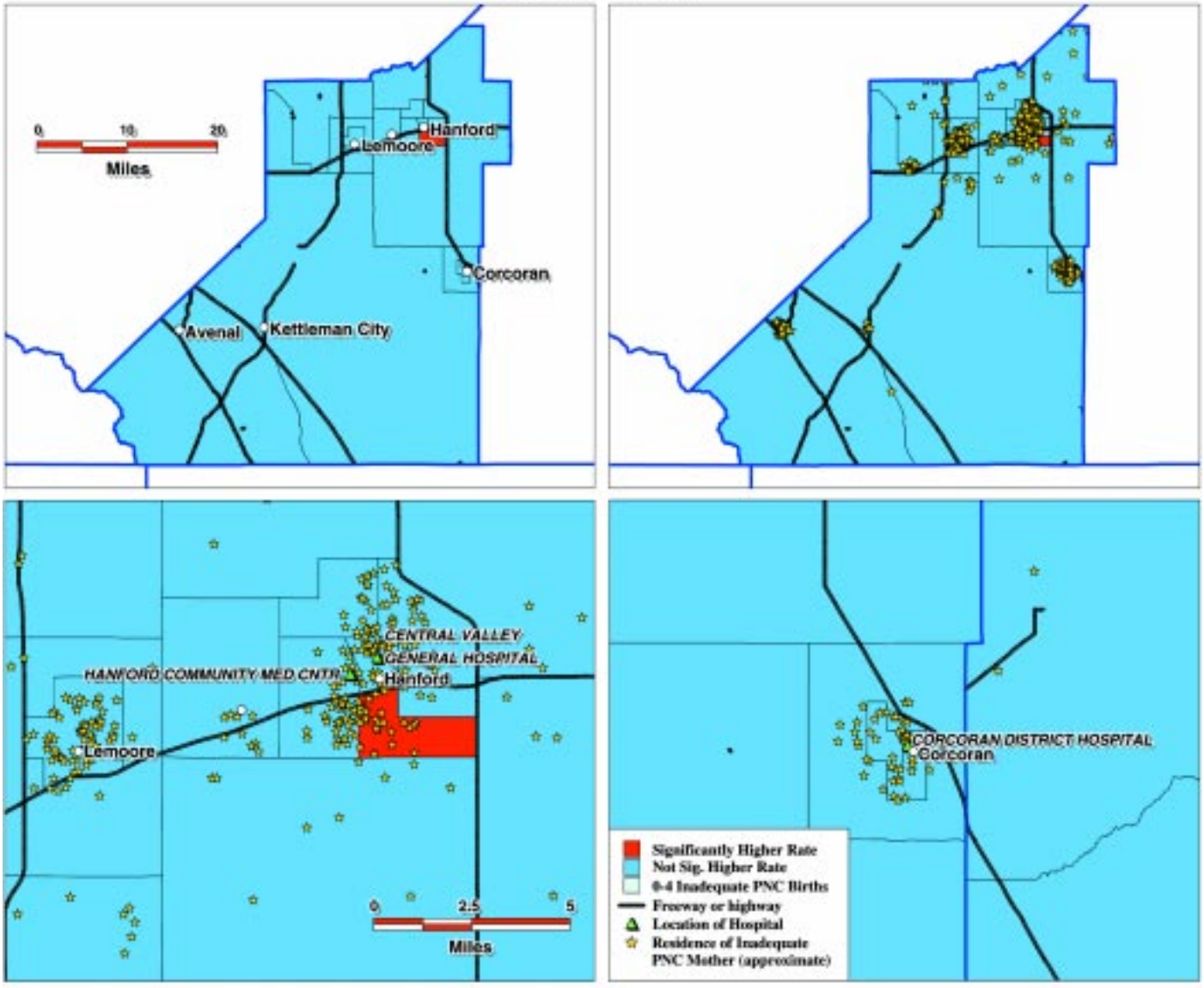
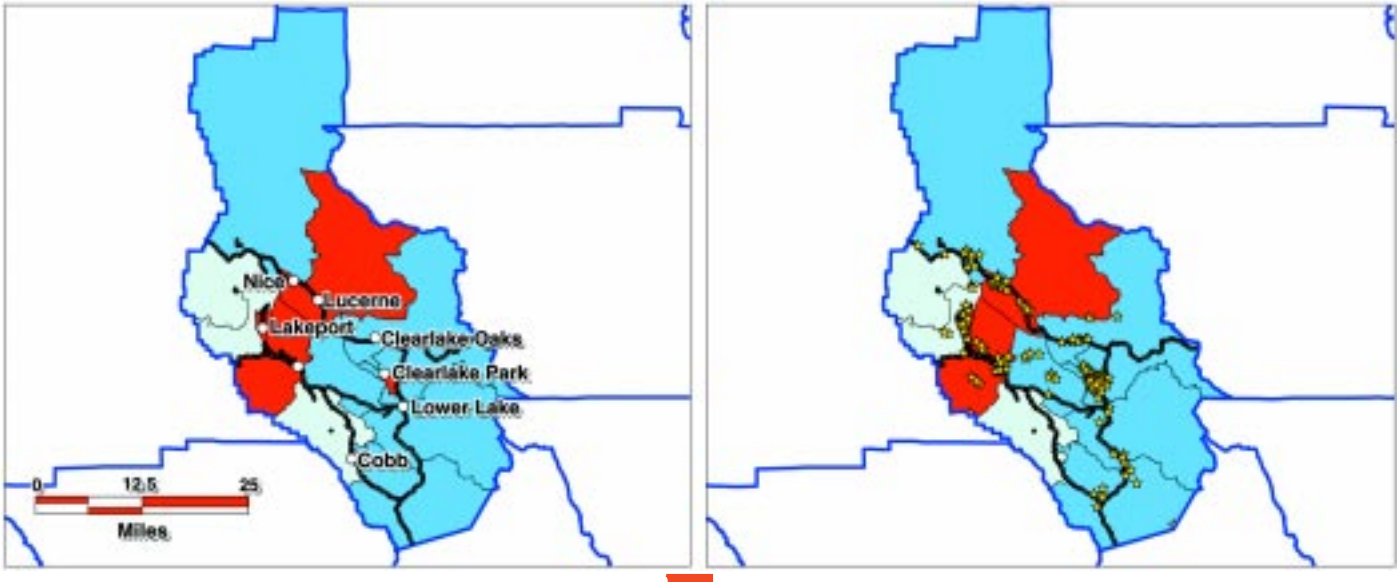


Kings County



Lake County



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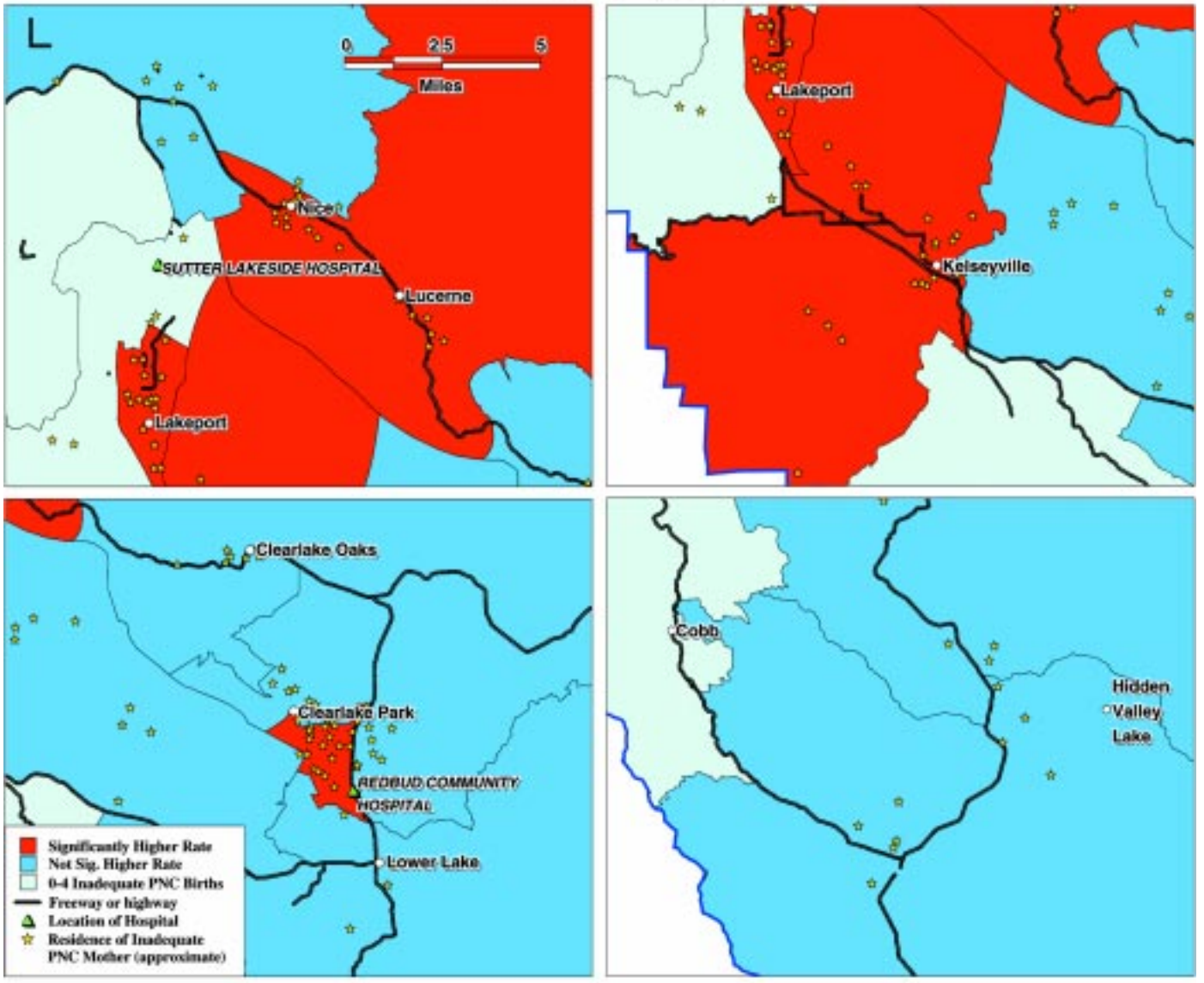
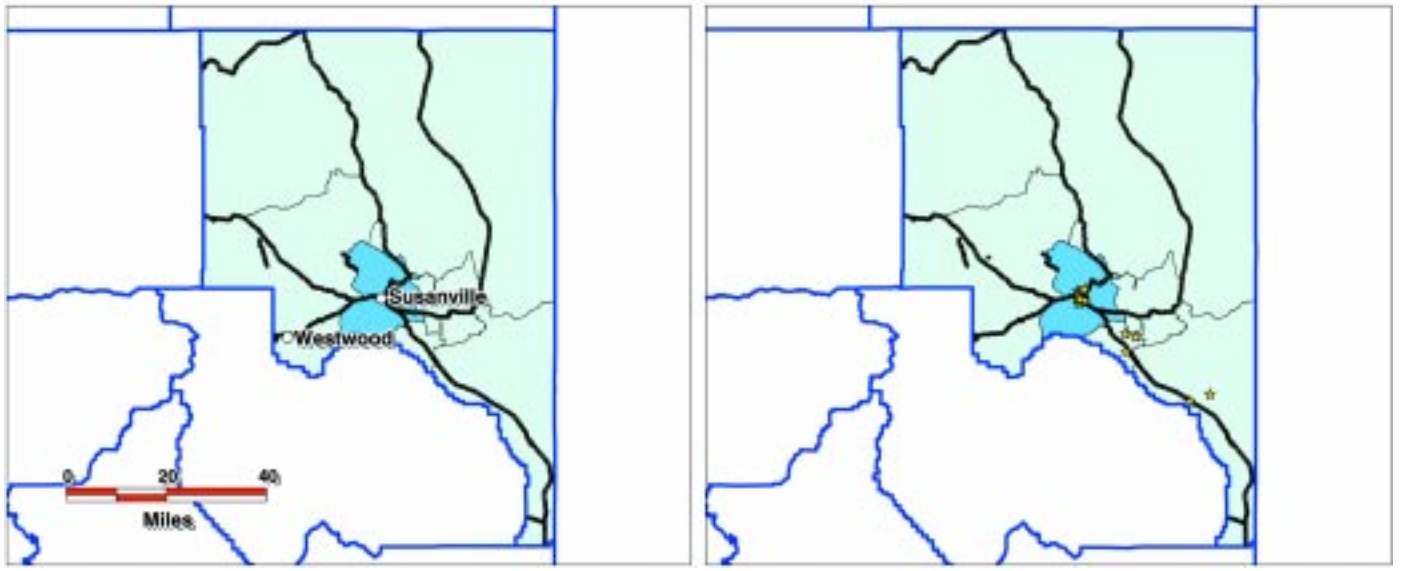
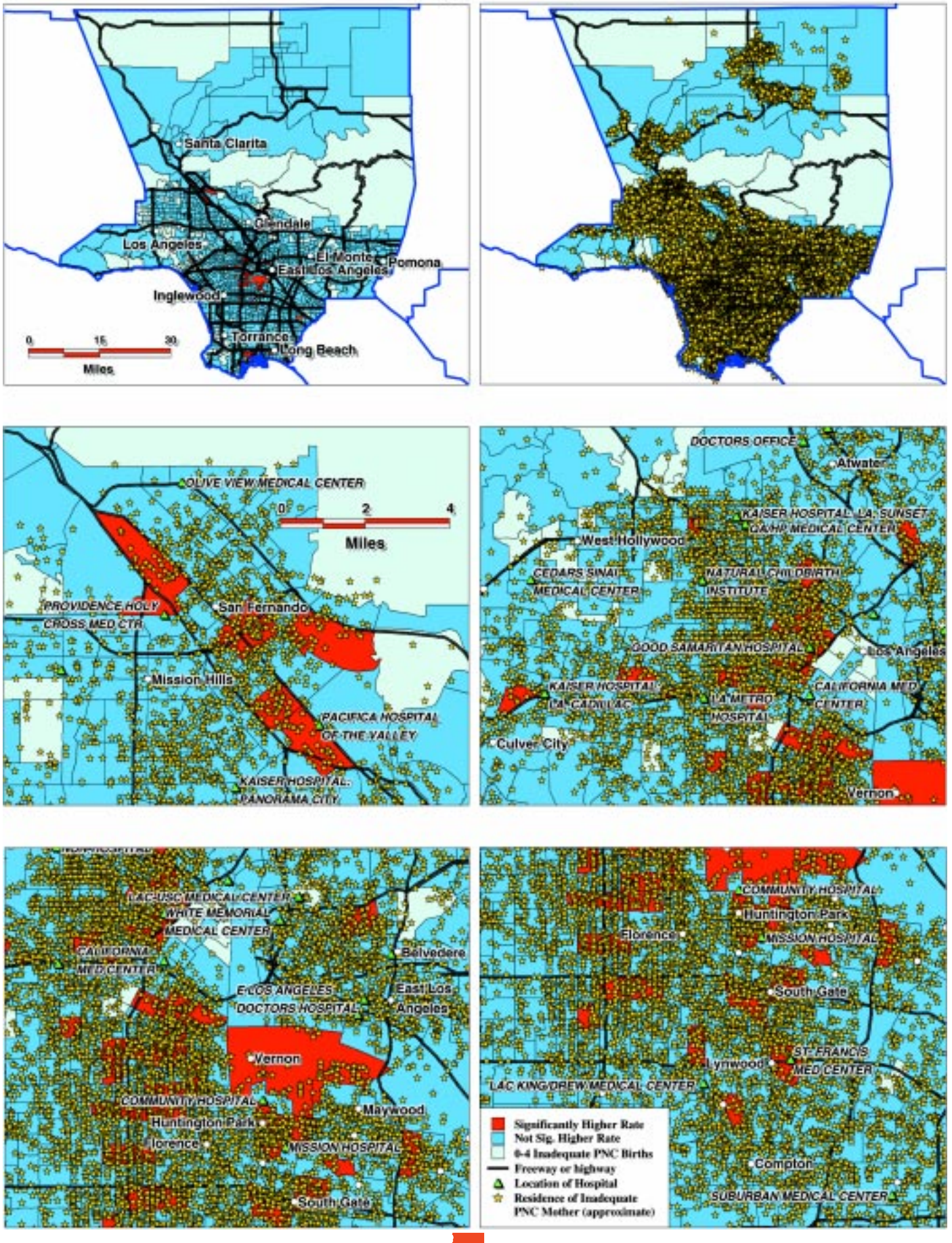


Lassen County



Los Angeles County



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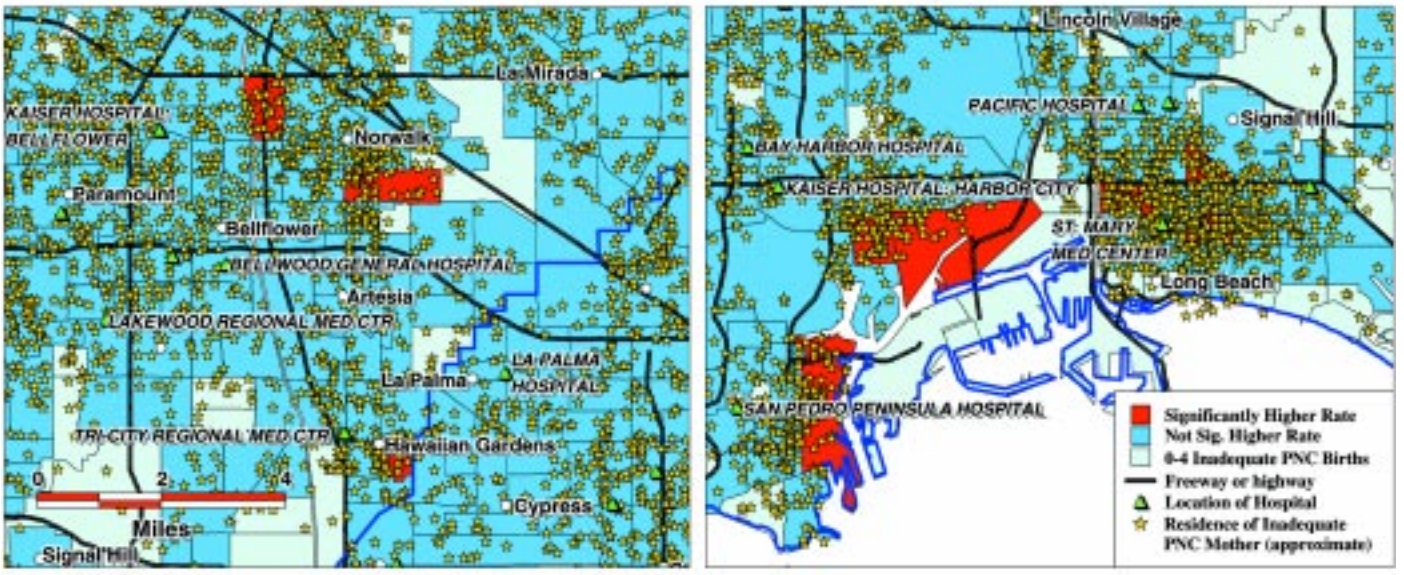
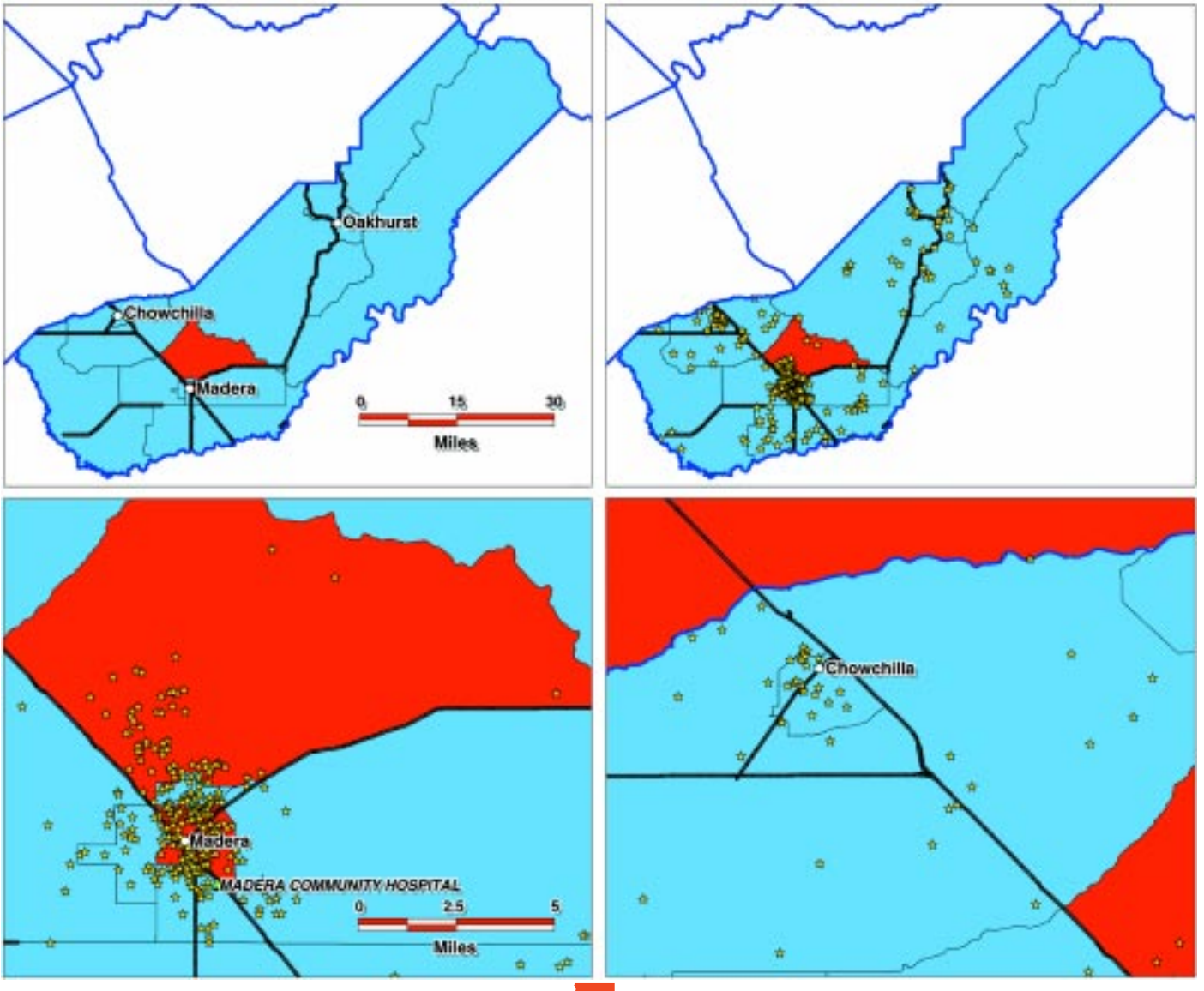
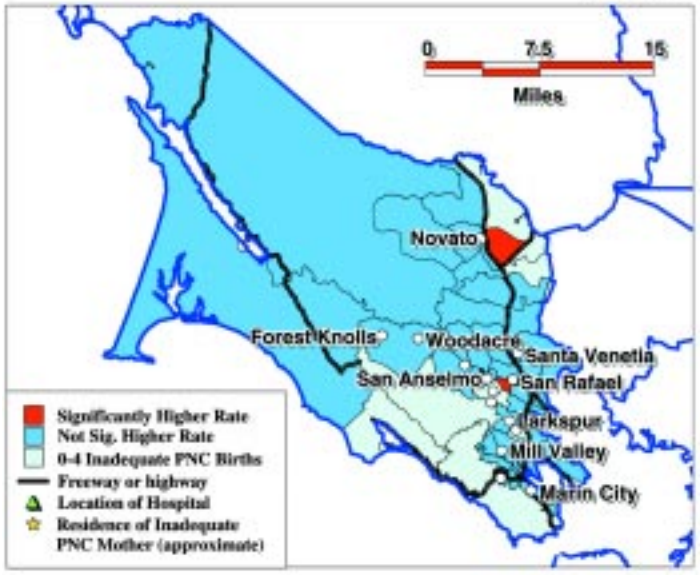
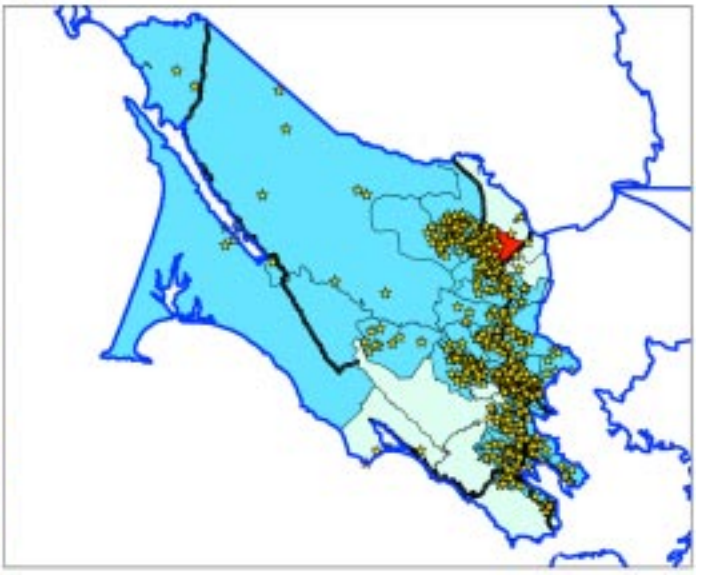


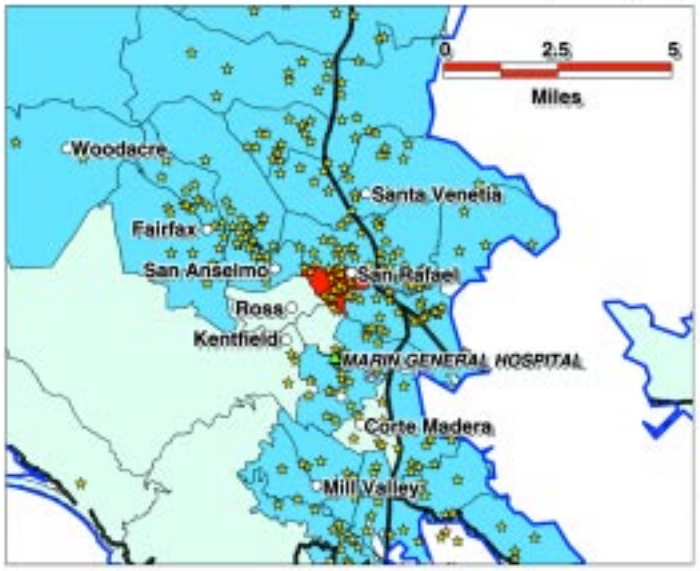
Madera County

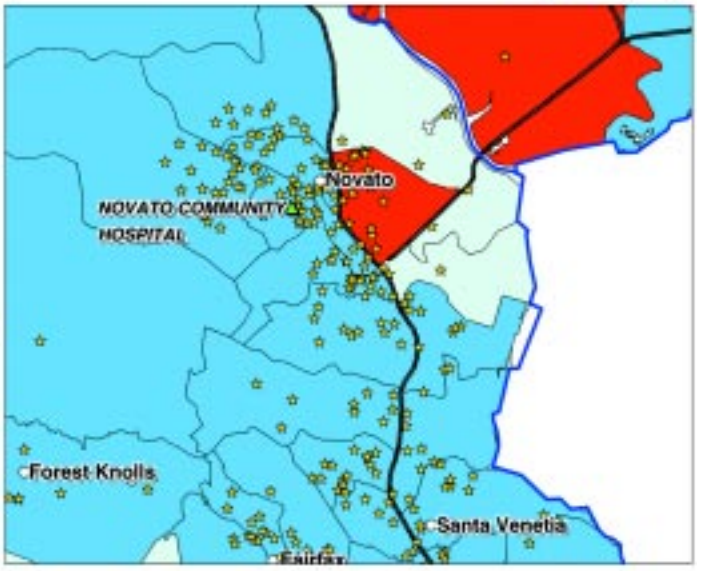


Marin County

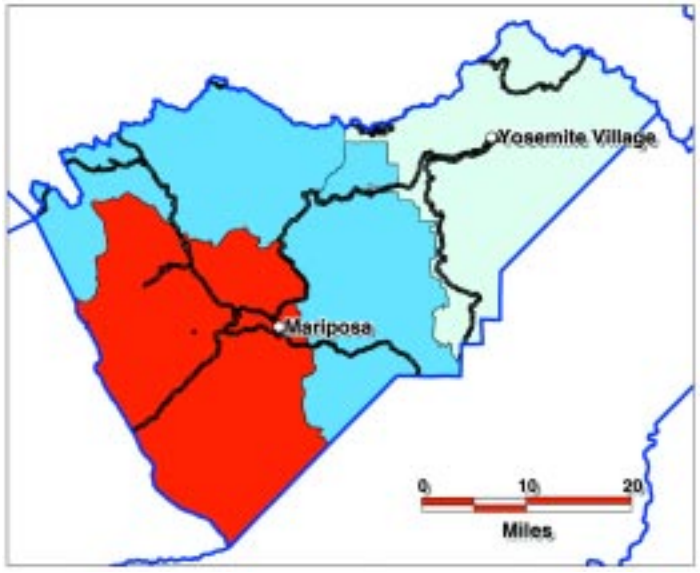


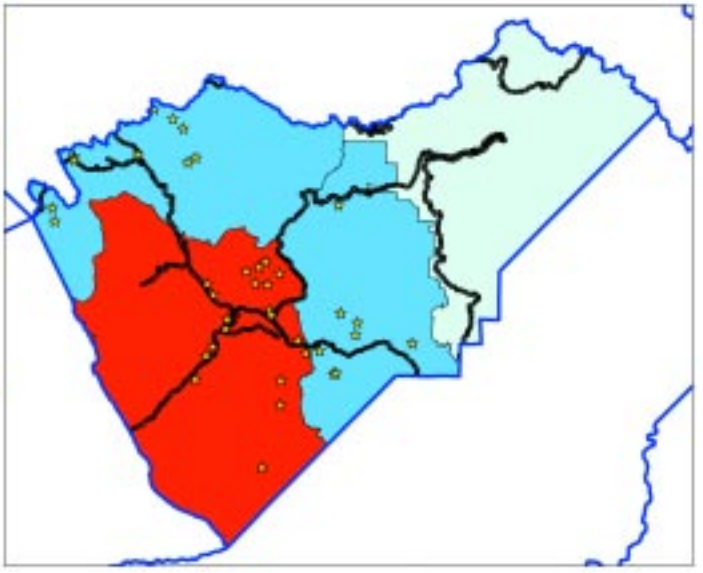






Mariposa County





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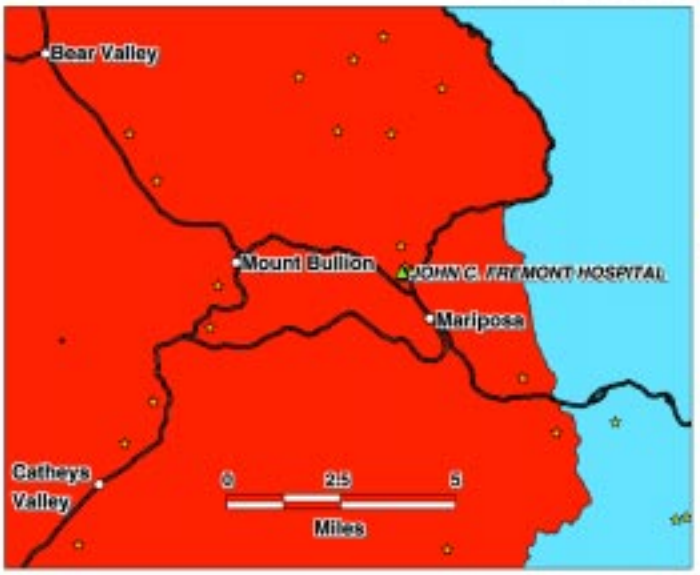
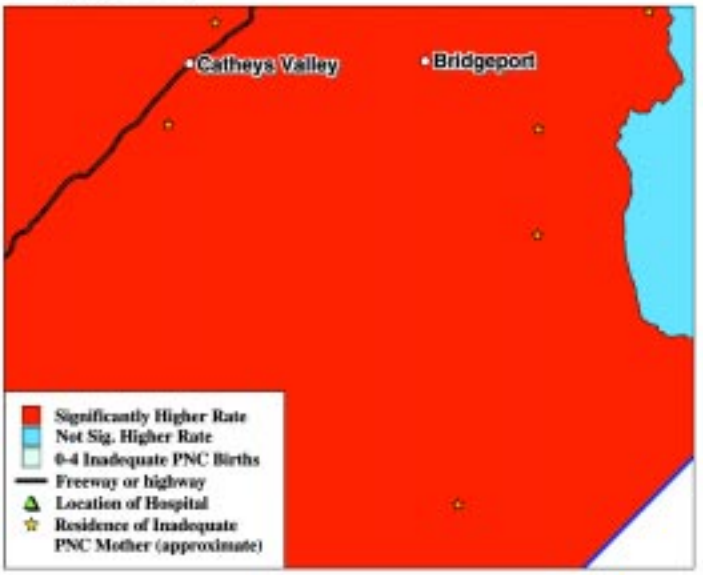
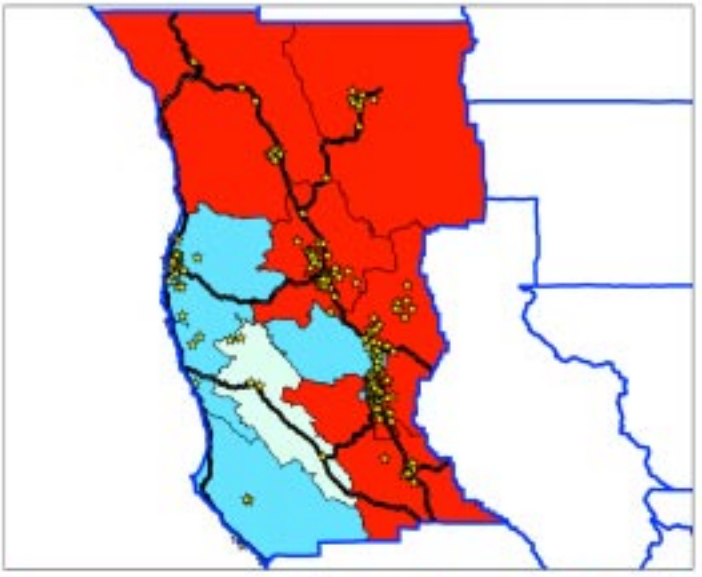
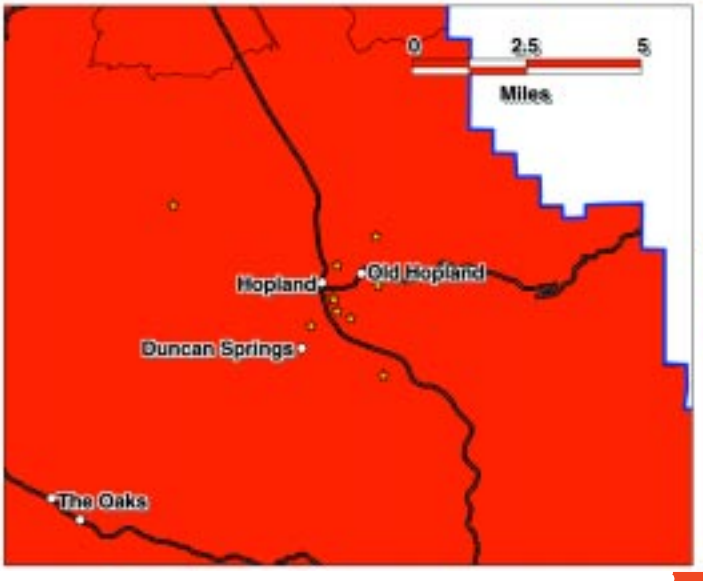




Mendocino County





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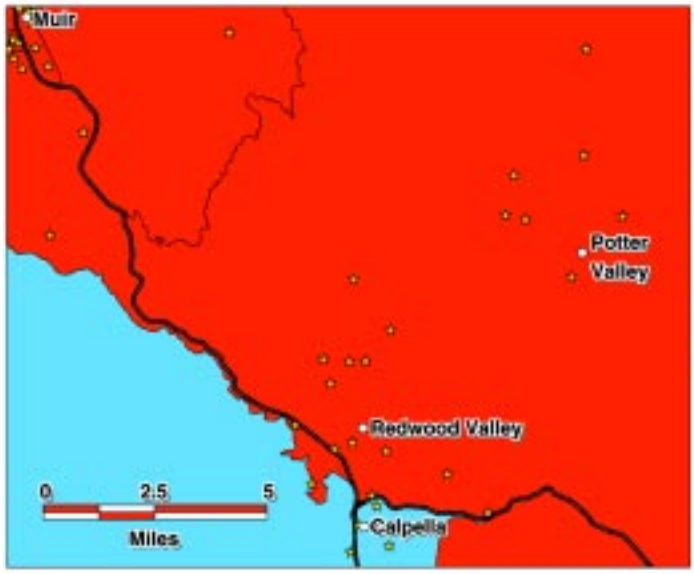
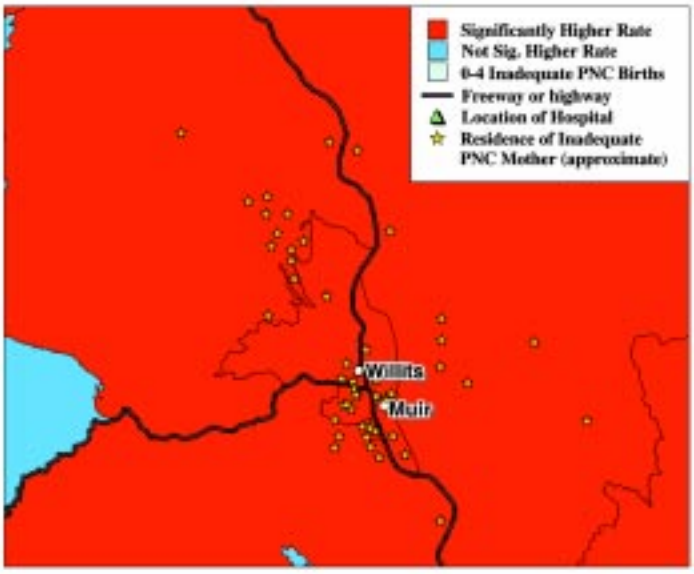
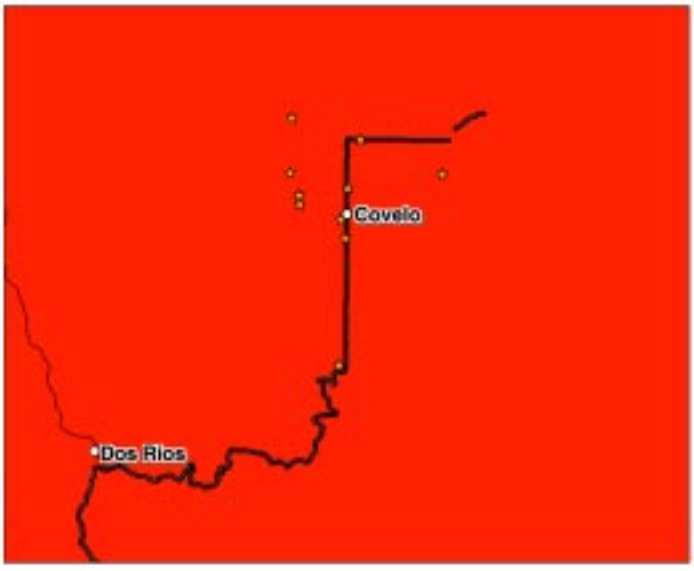
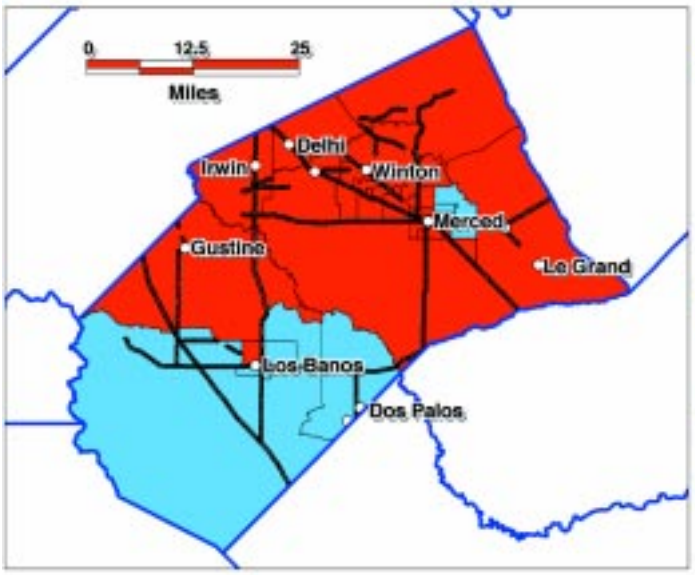
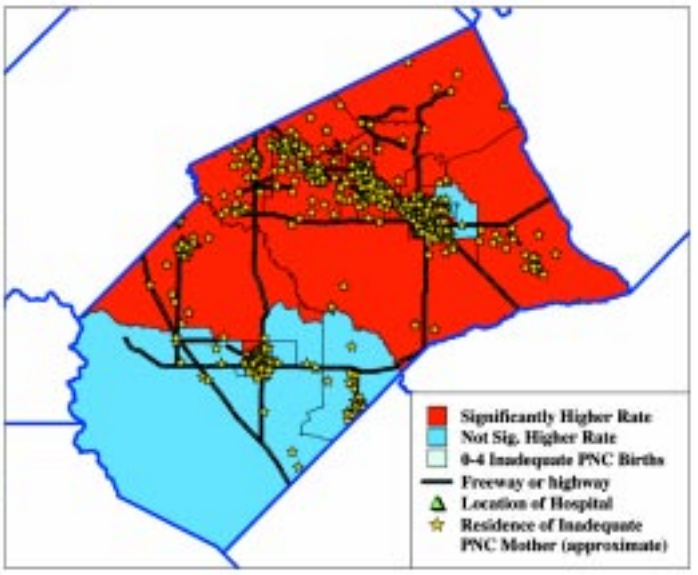


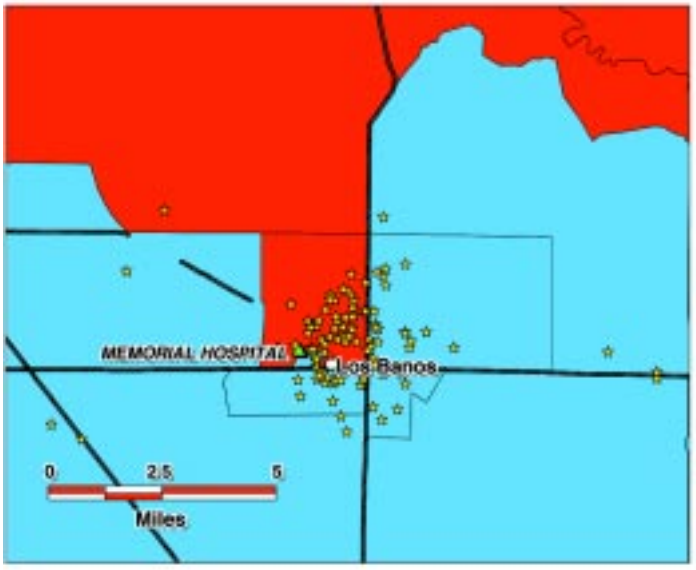


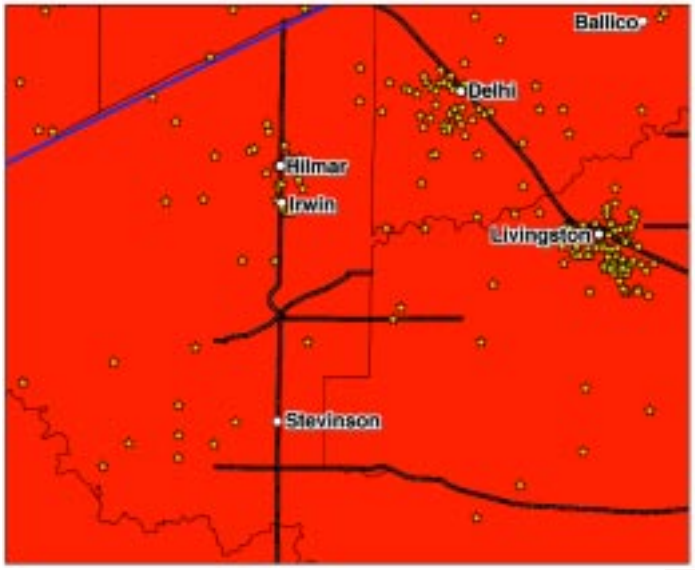


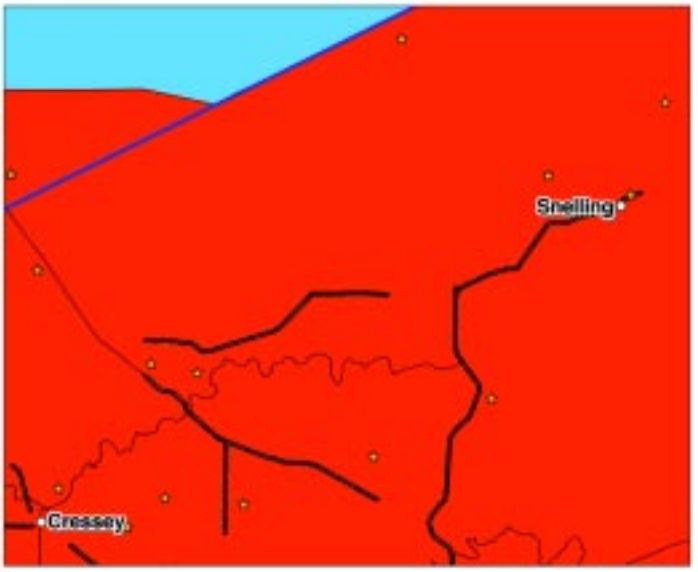
Merced County











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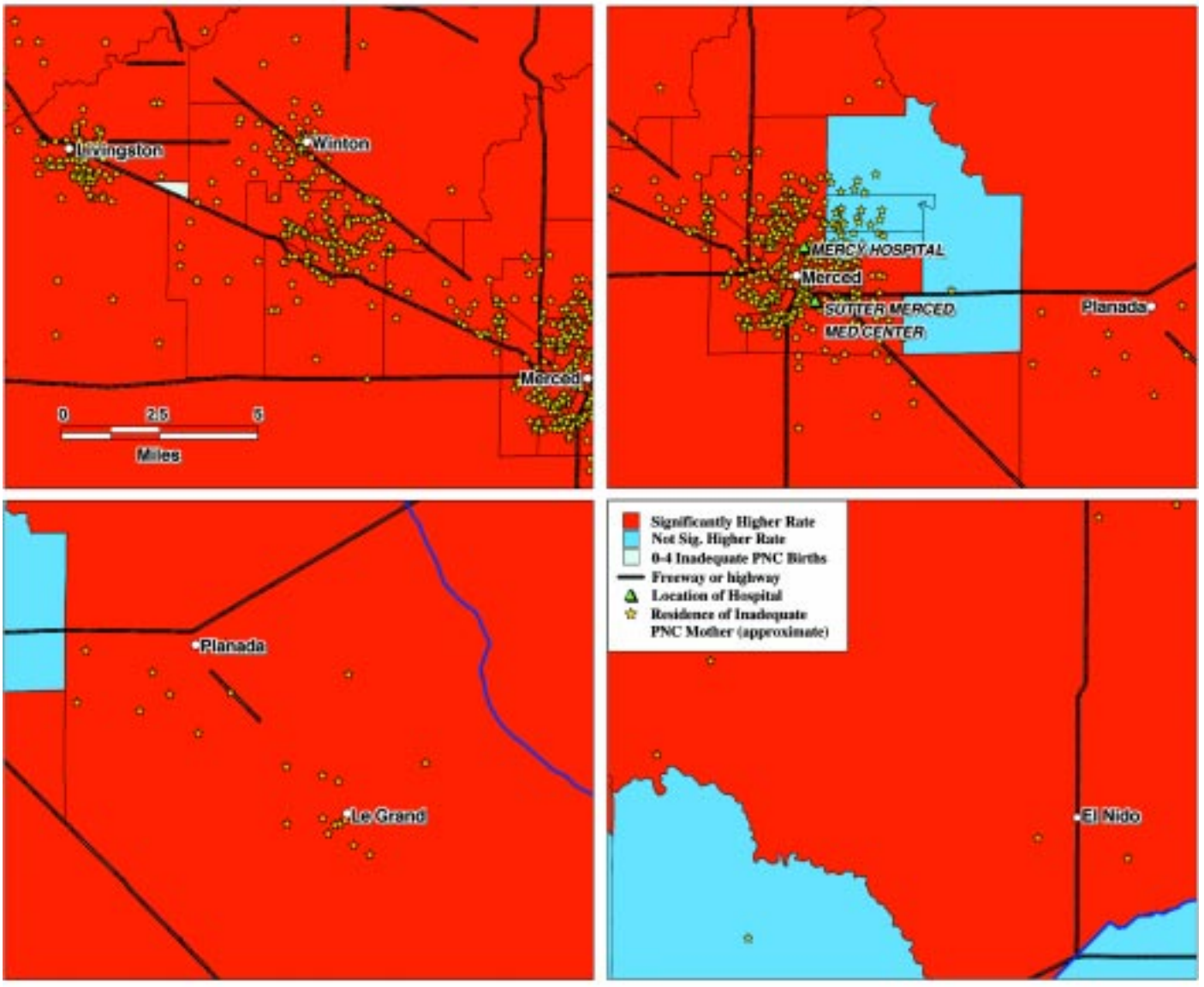
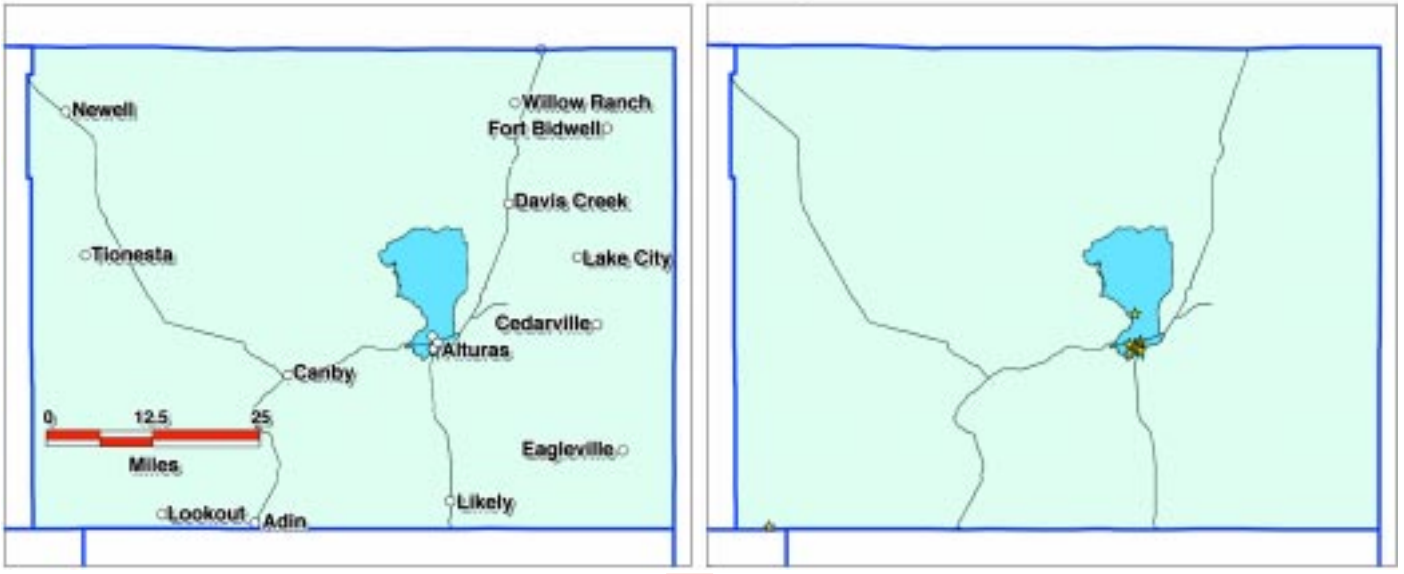
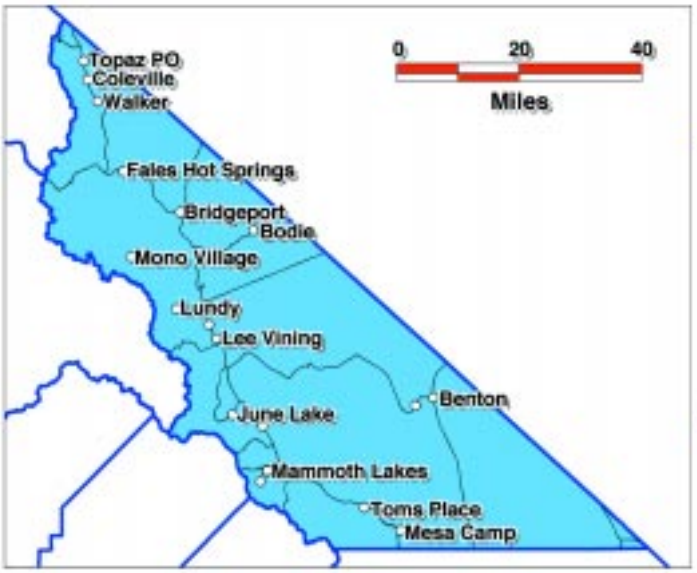
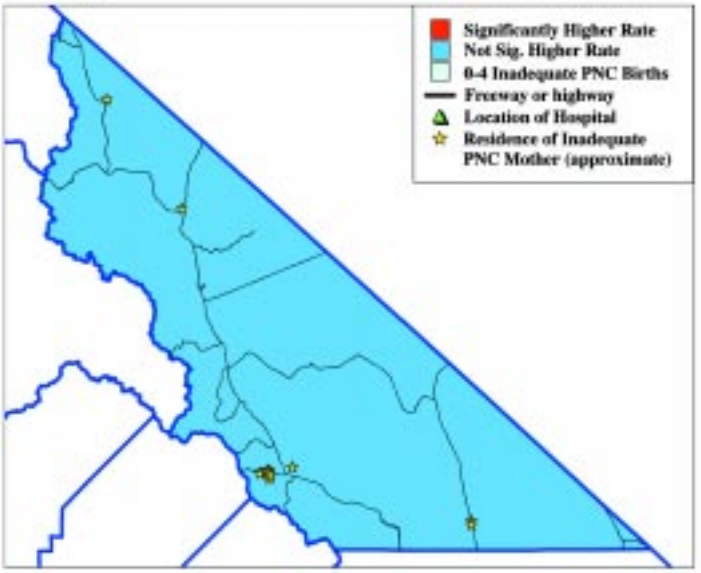


Modoc County

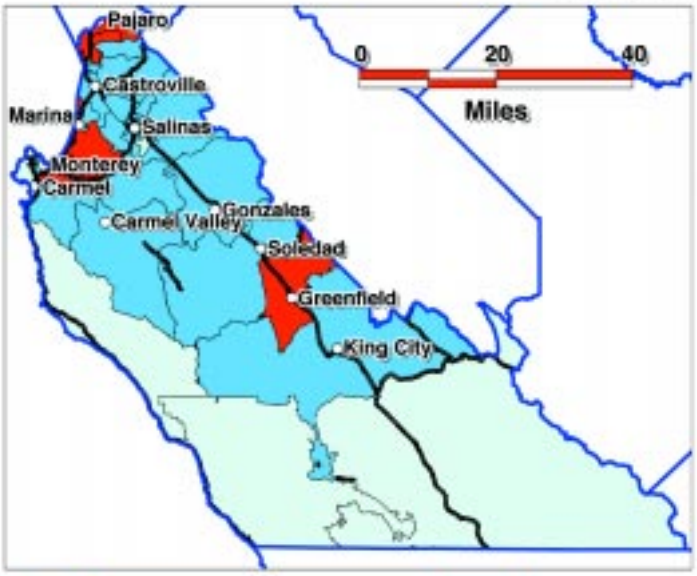


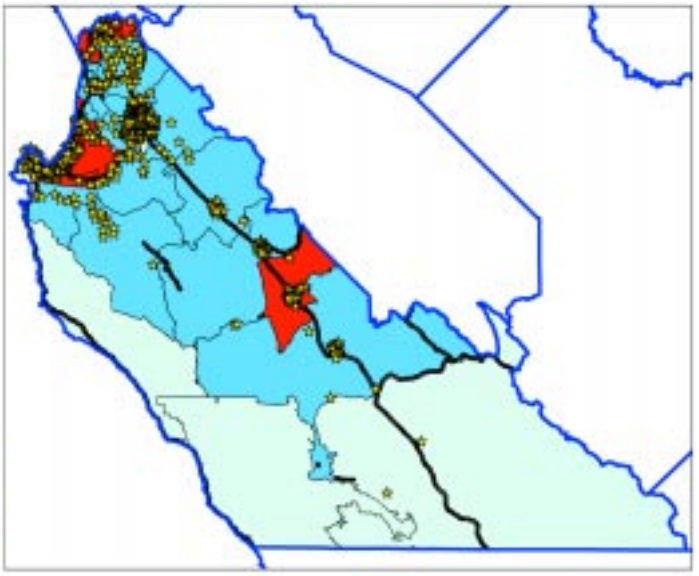
Mono County





Monterey County





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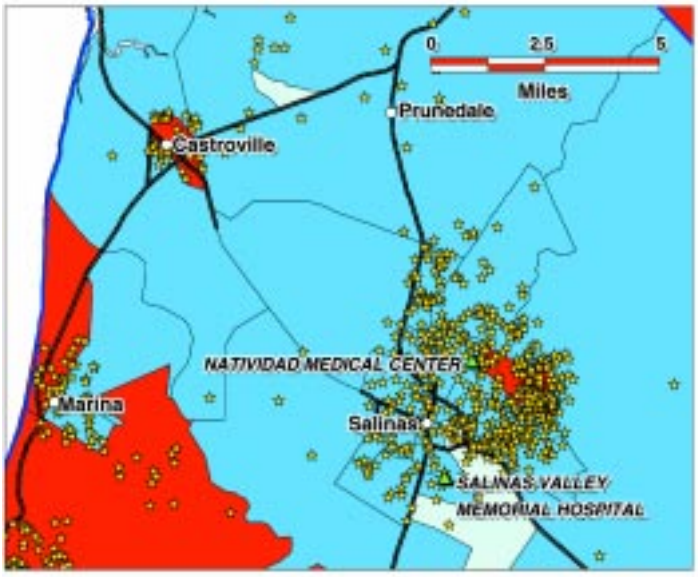
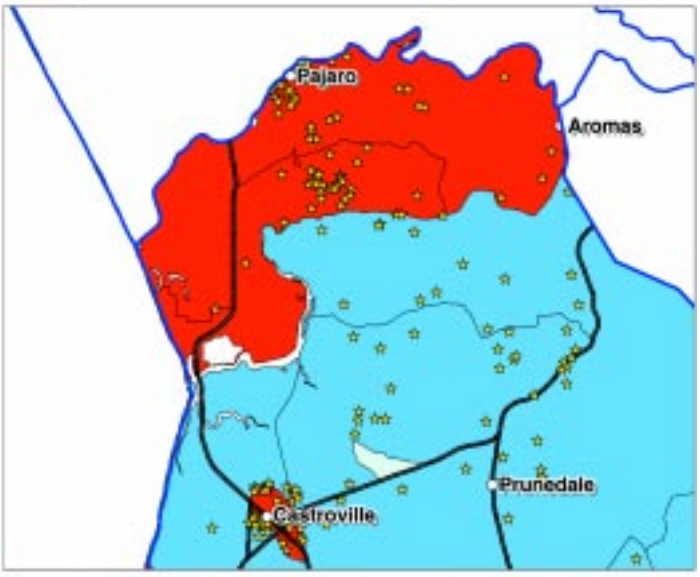
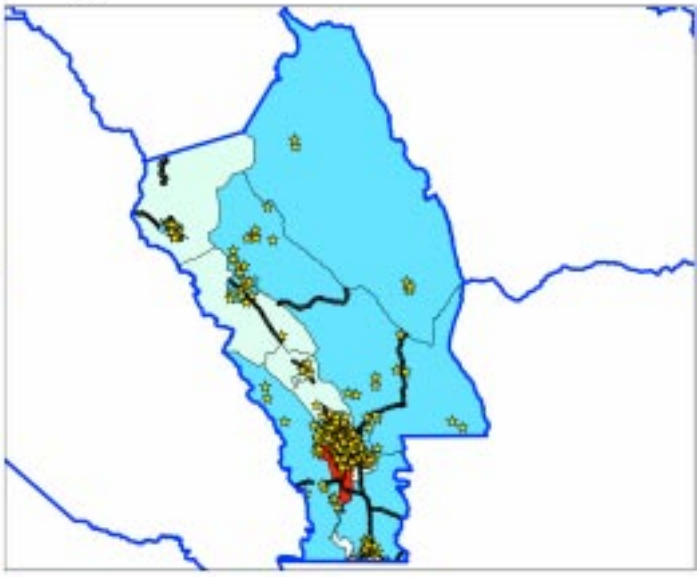
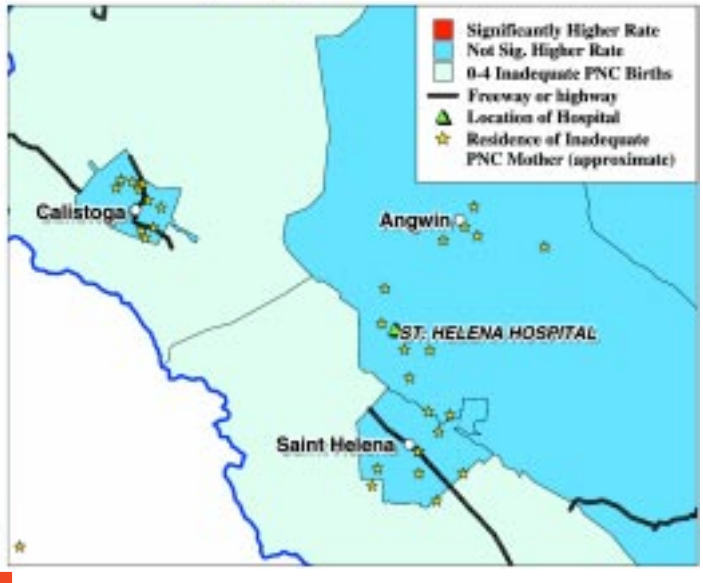


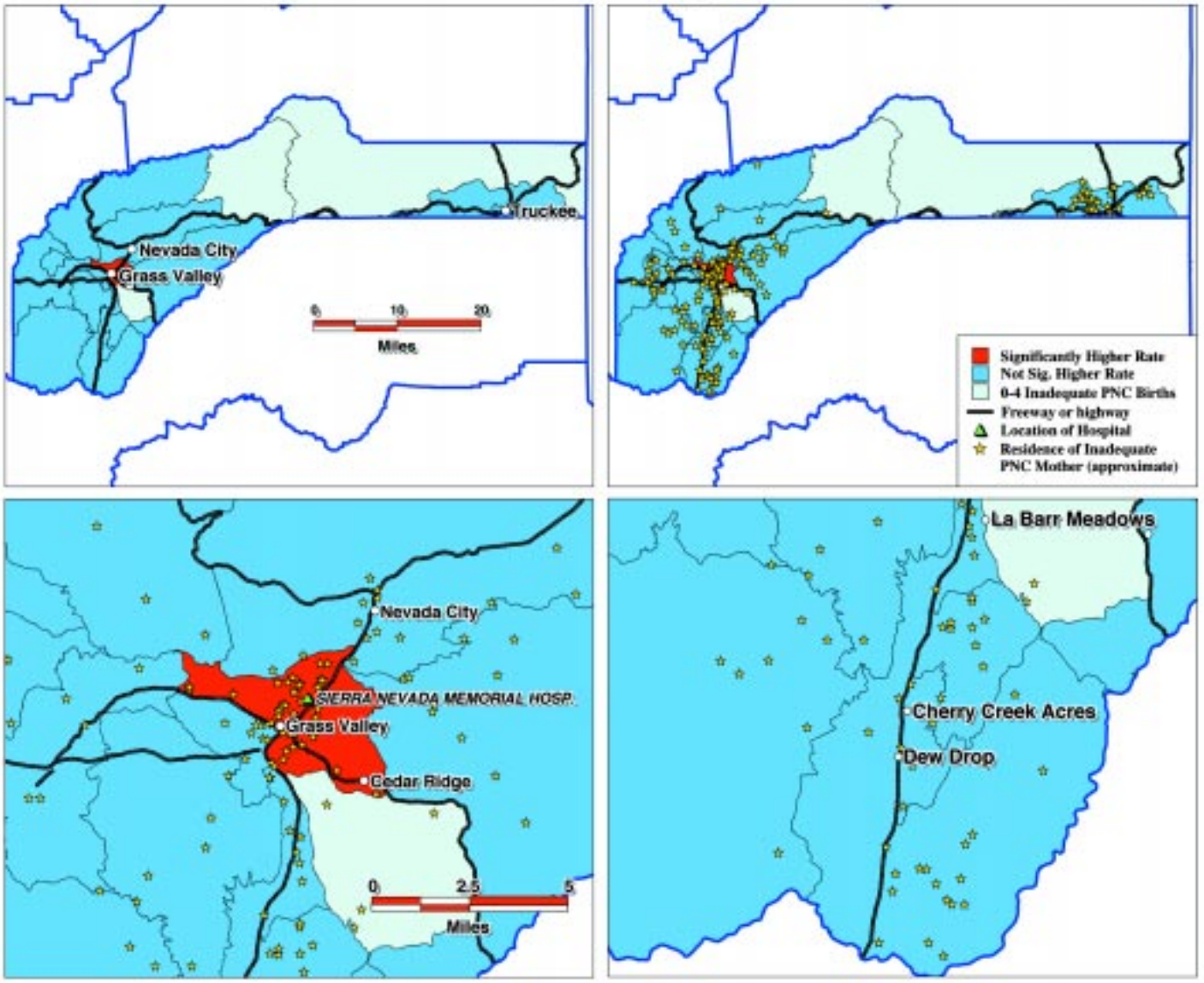


Napa County

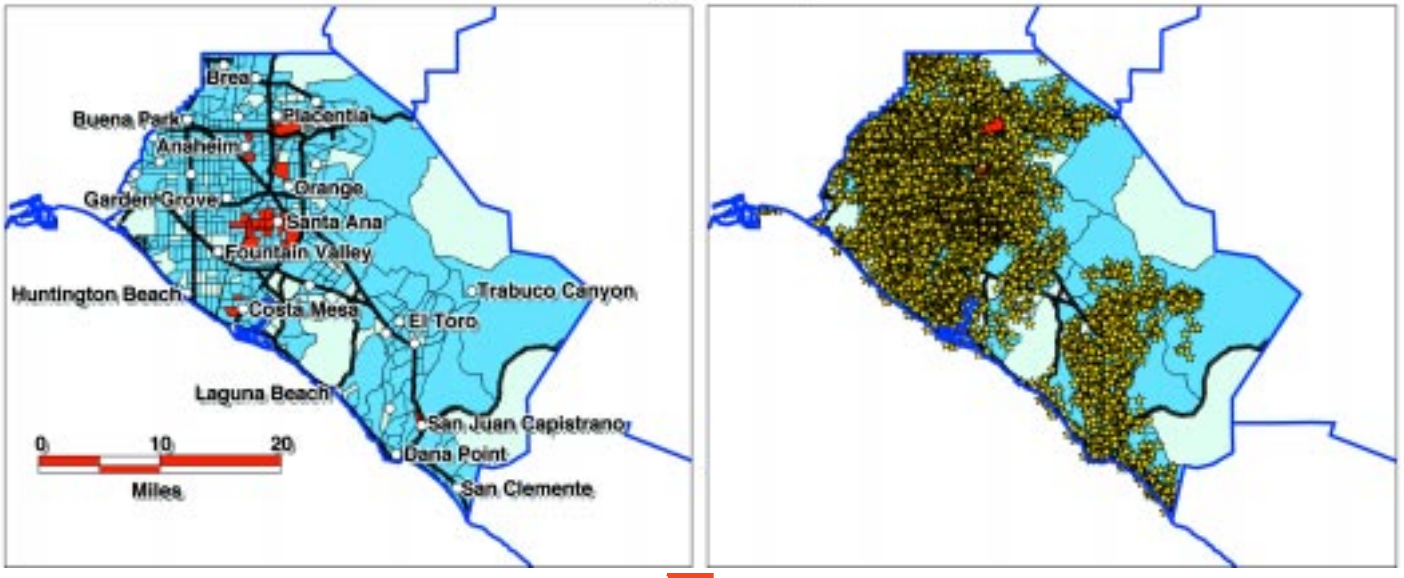




Nevada County



Orange County



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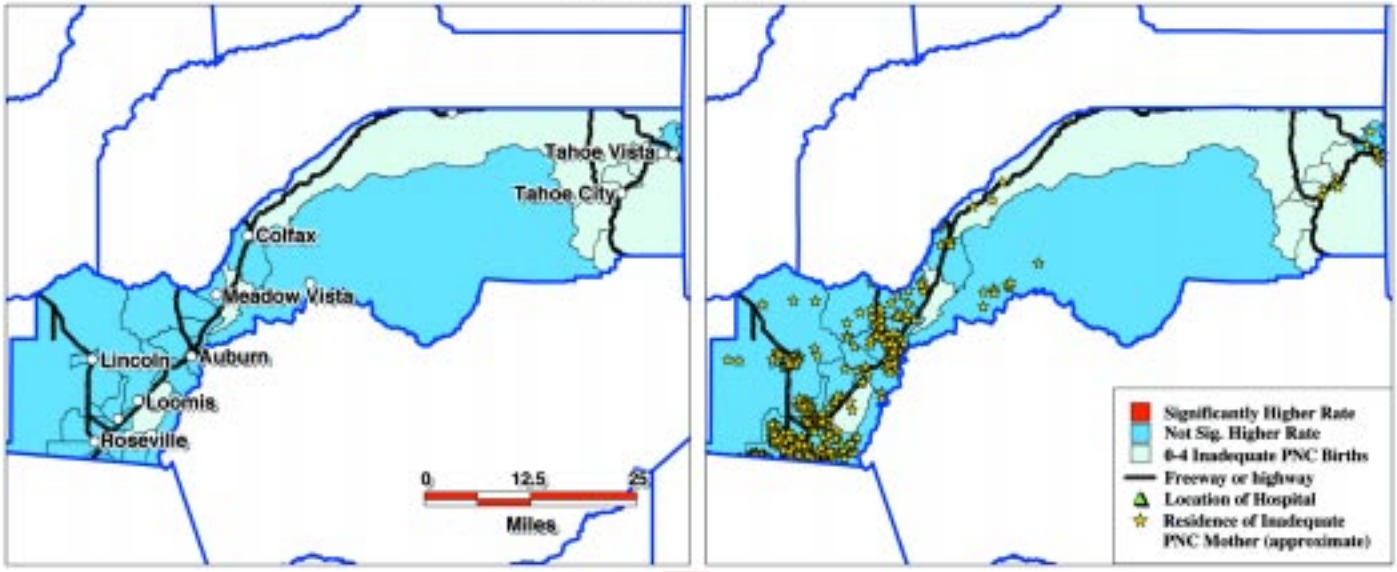
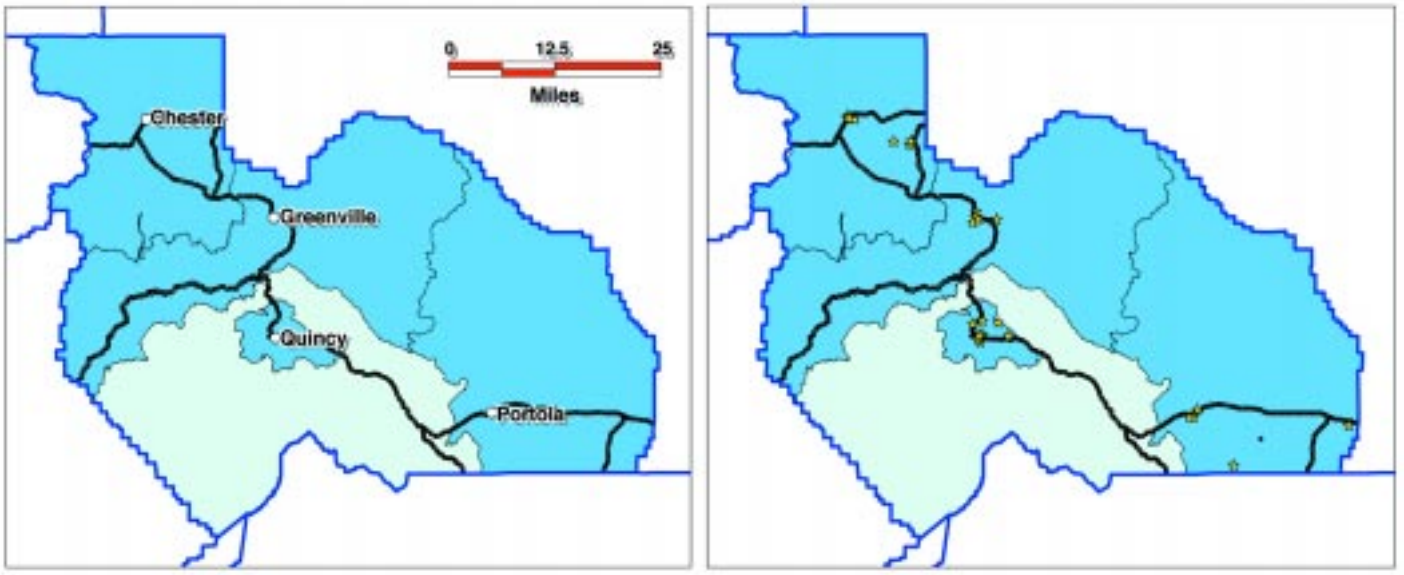
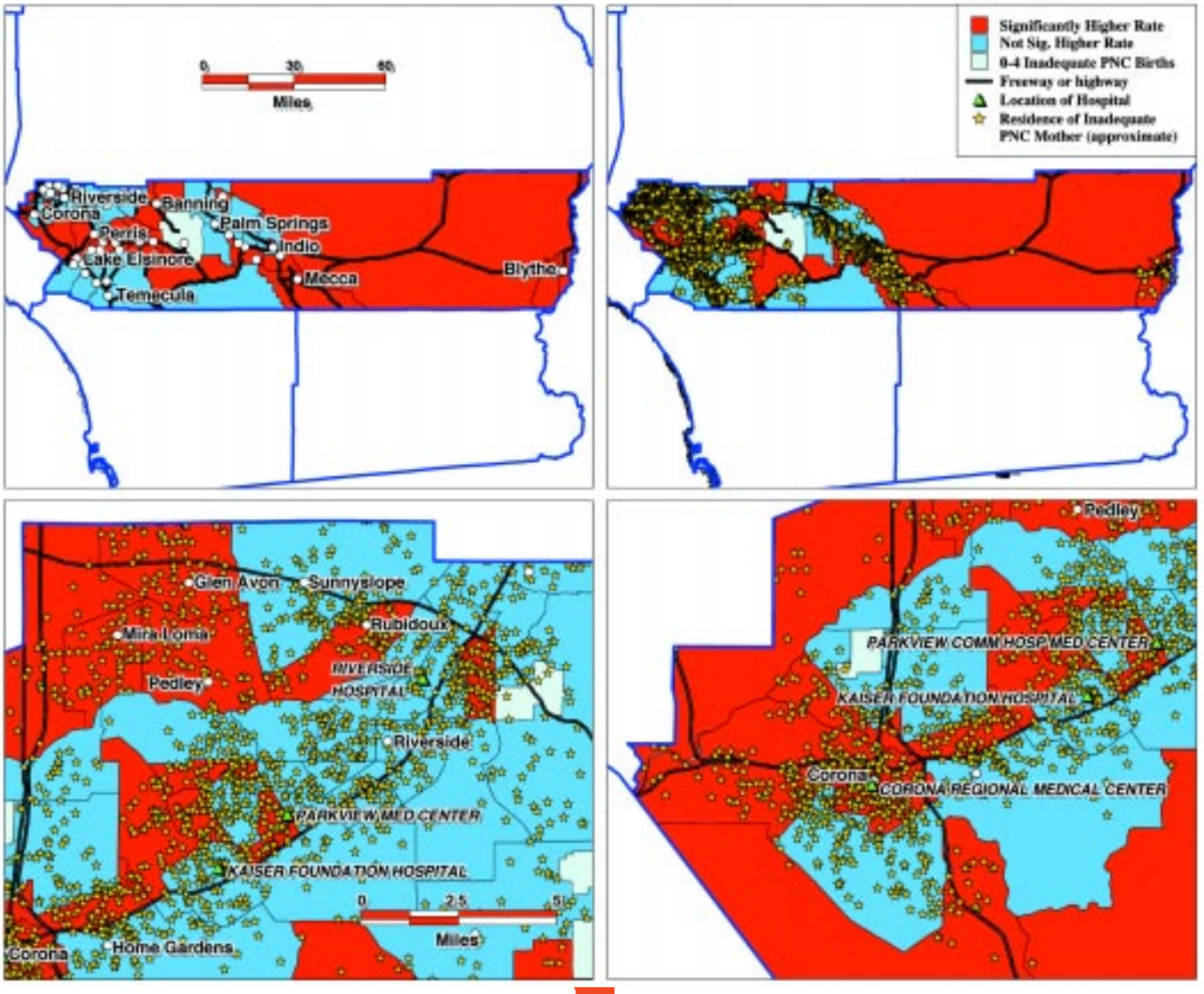
Placer County



Plumas County



Riverside County



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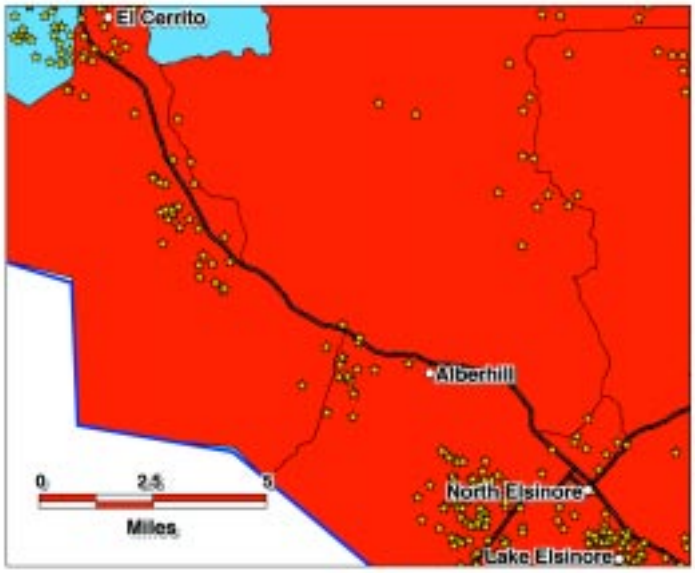

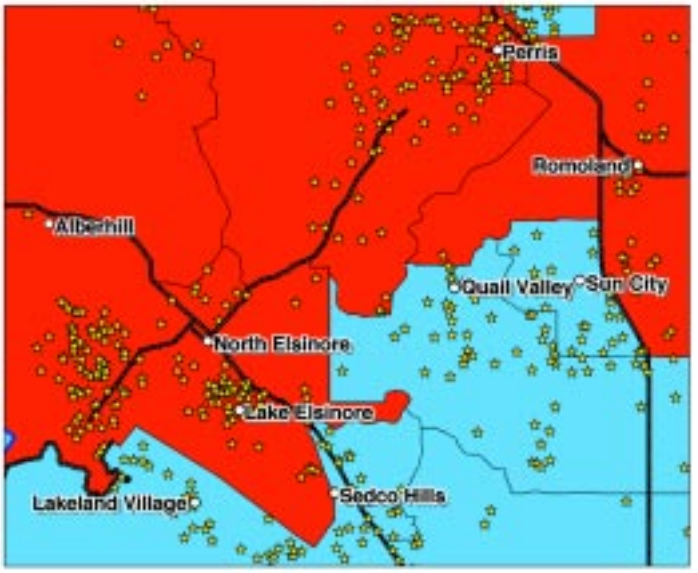

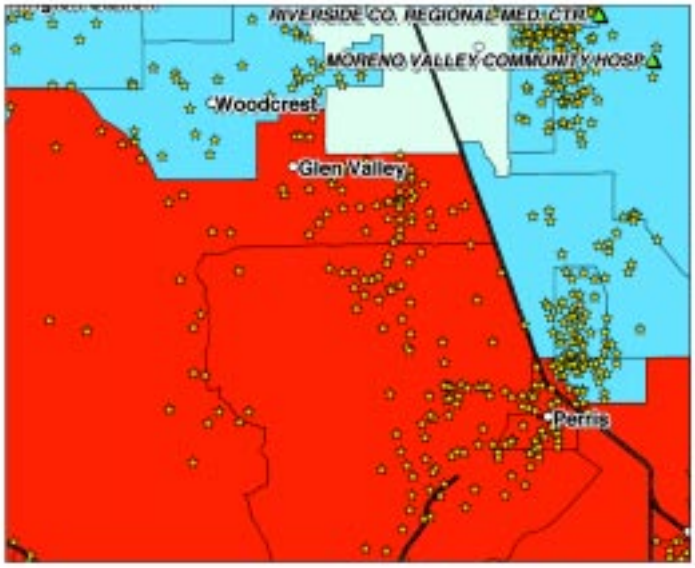

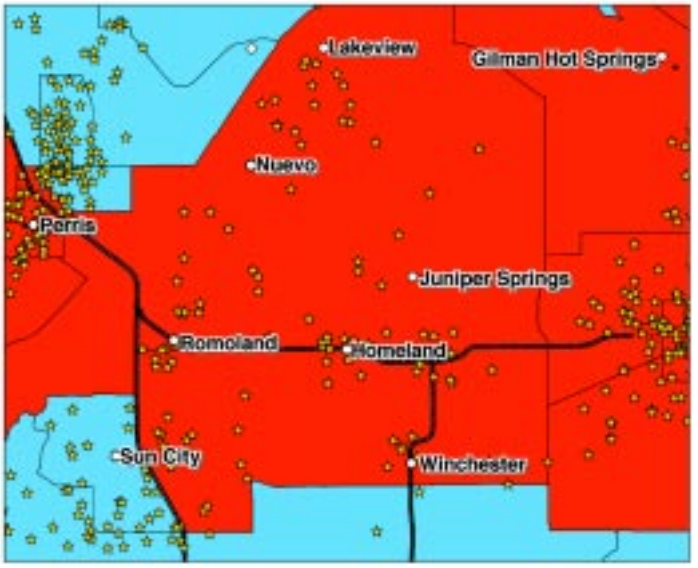

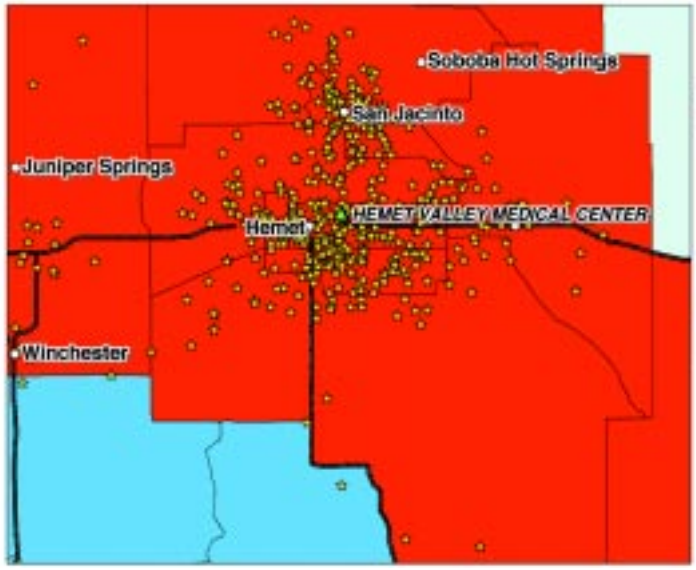

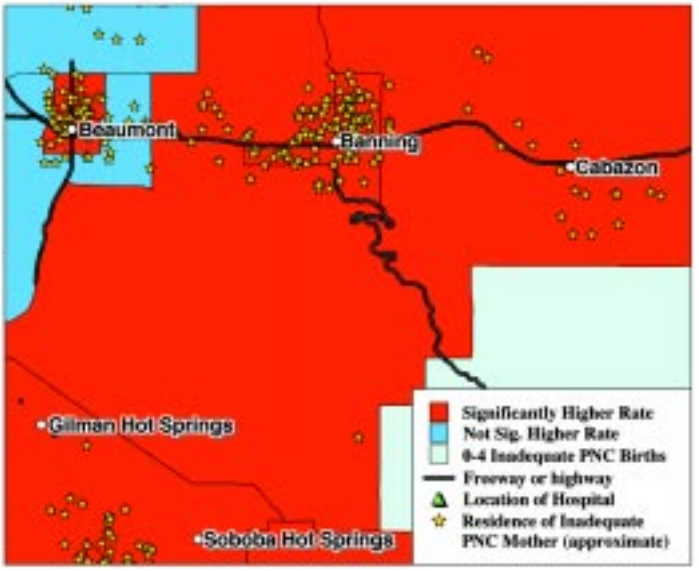

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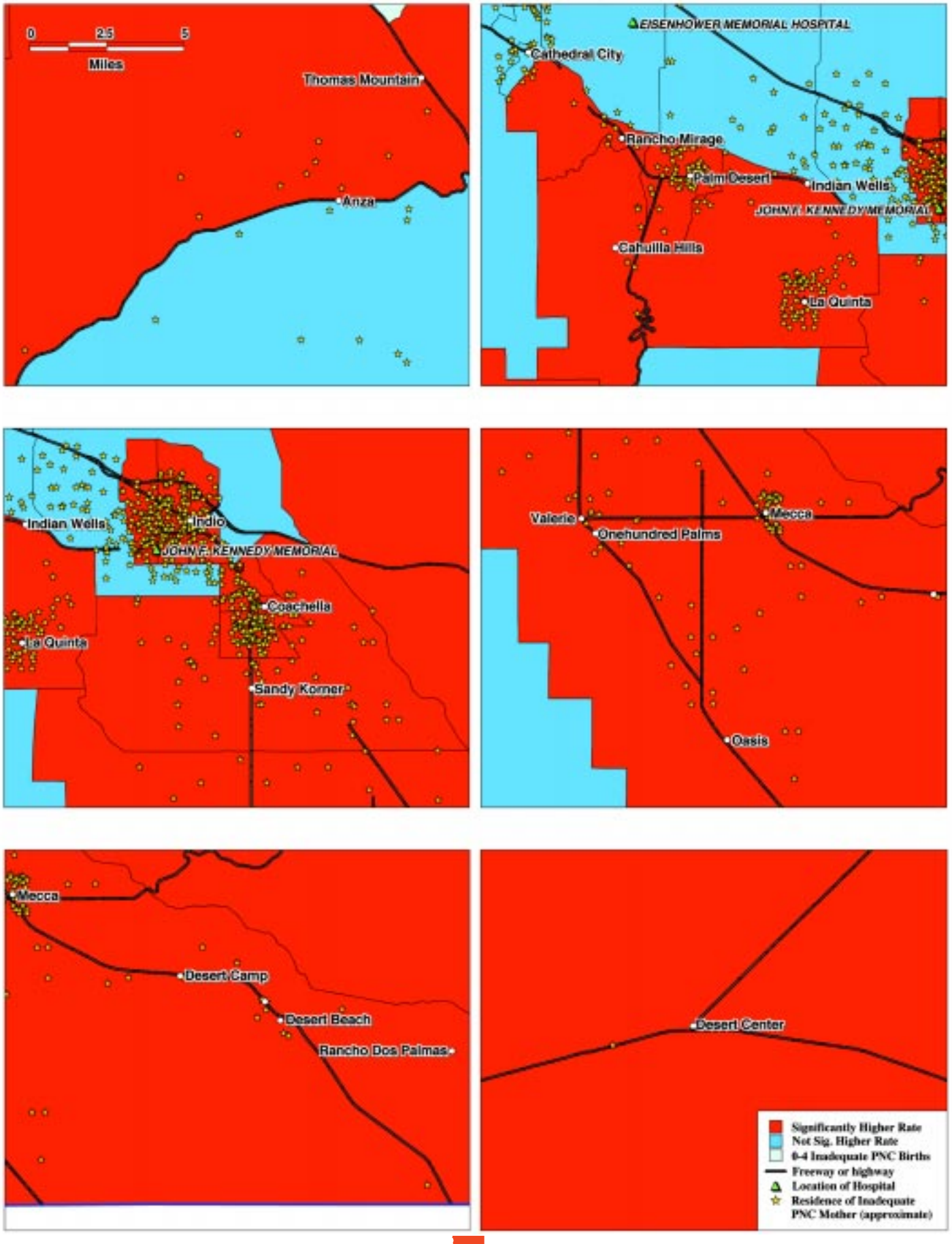

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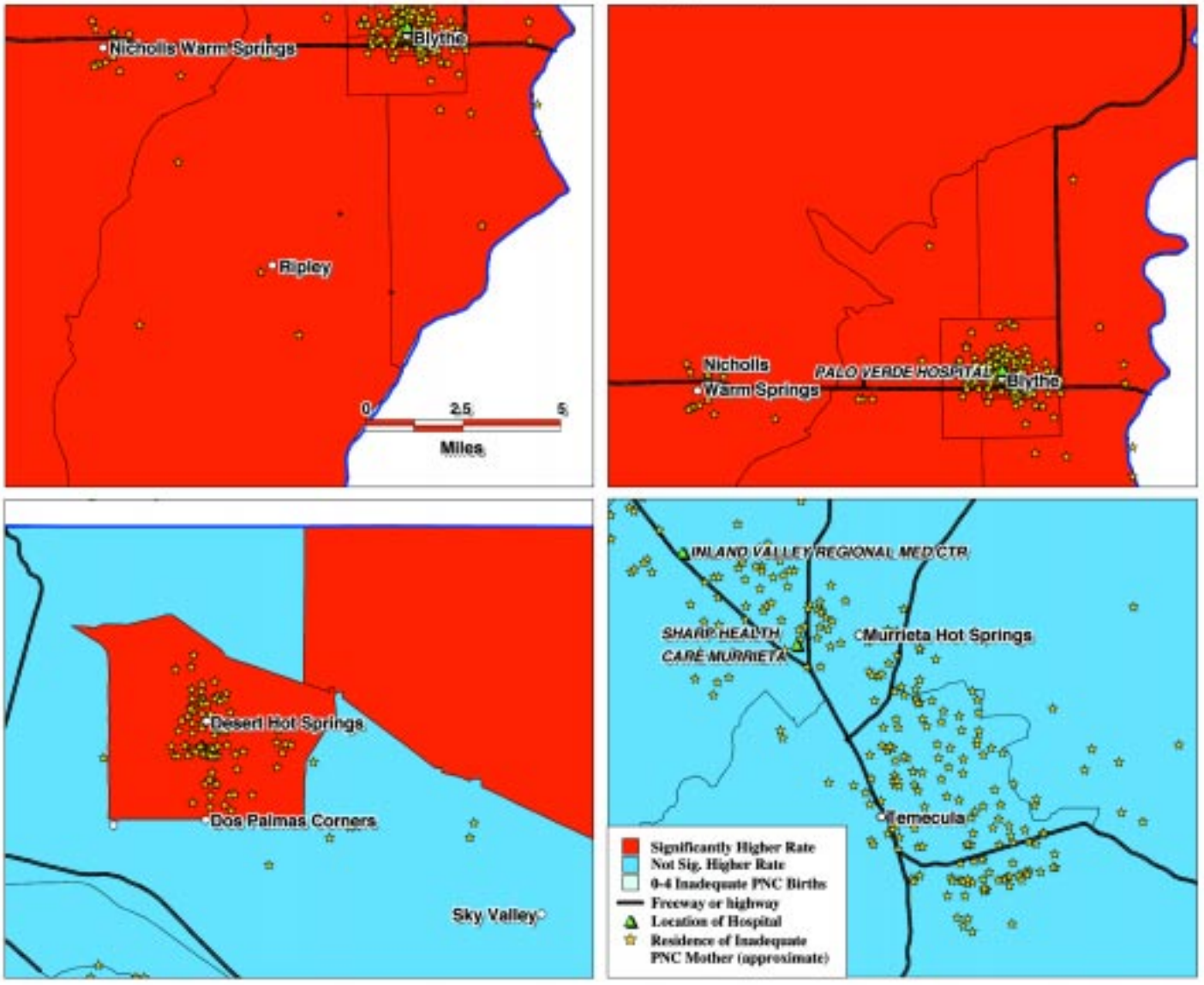
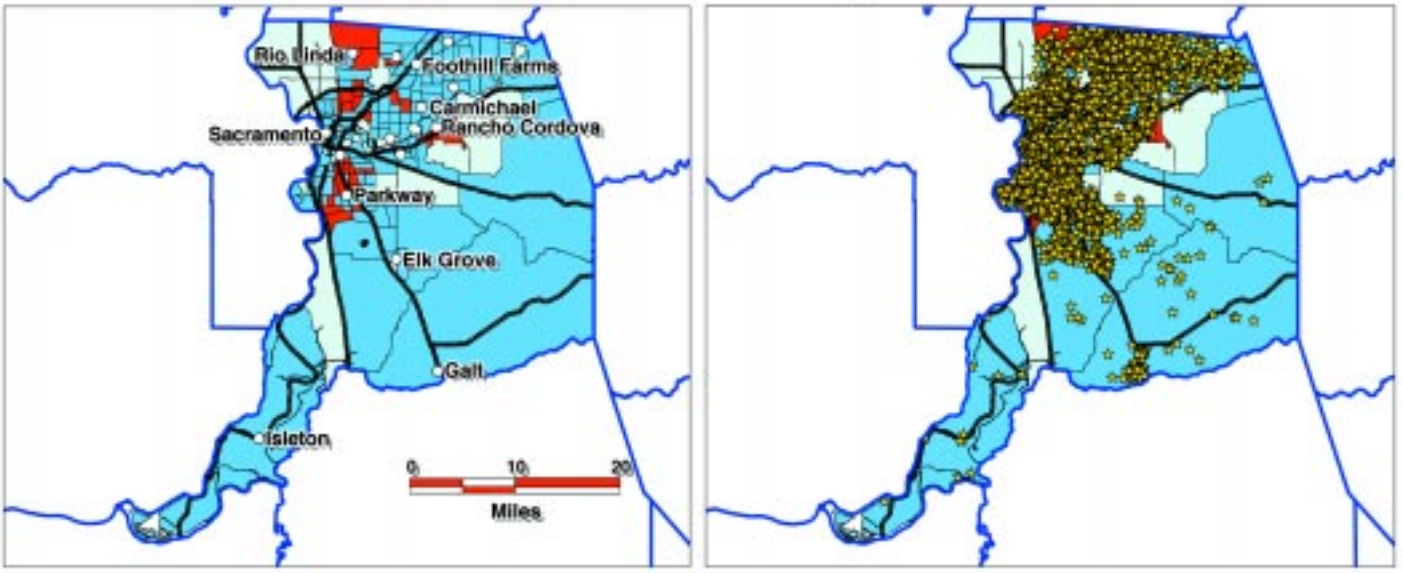
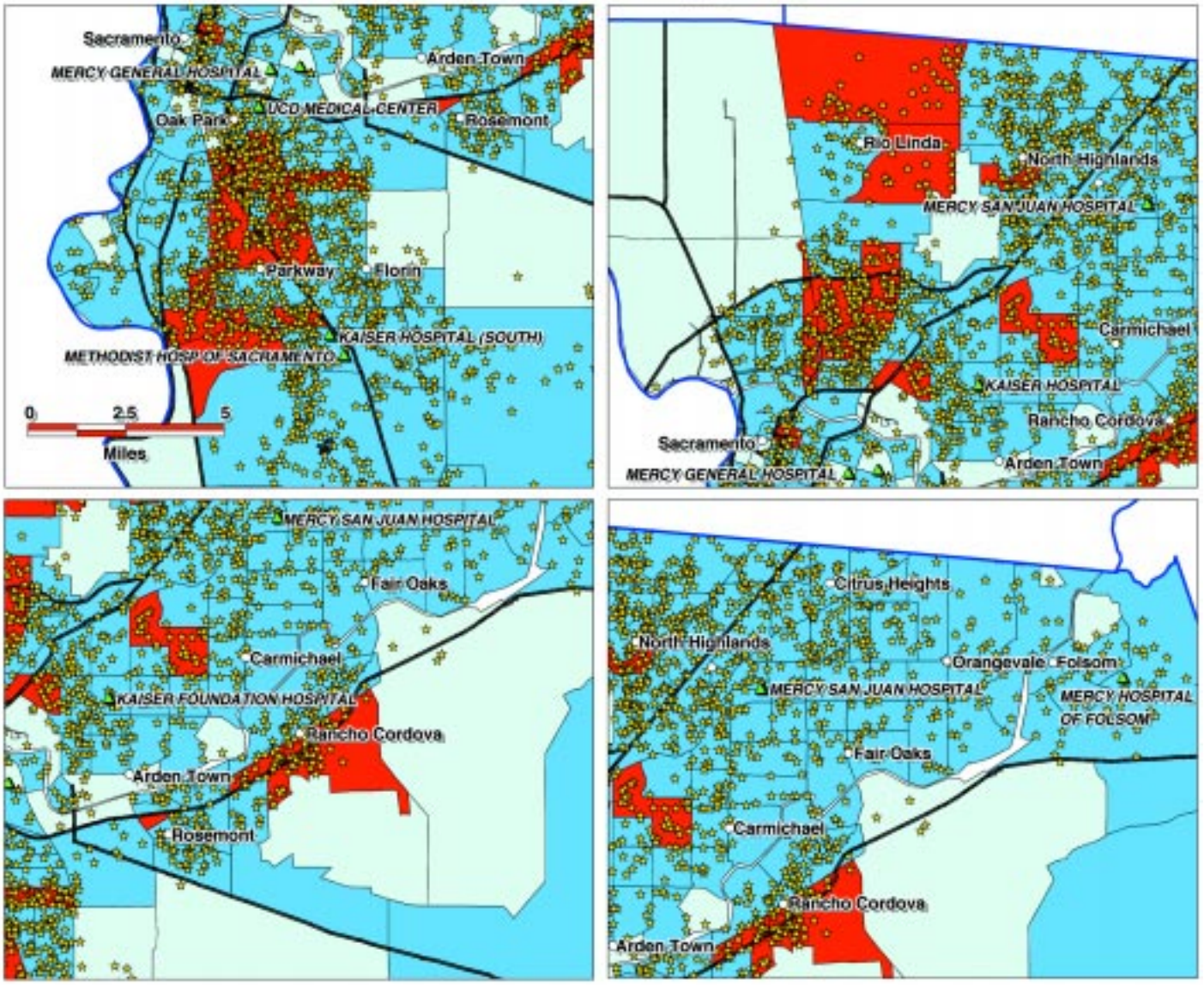


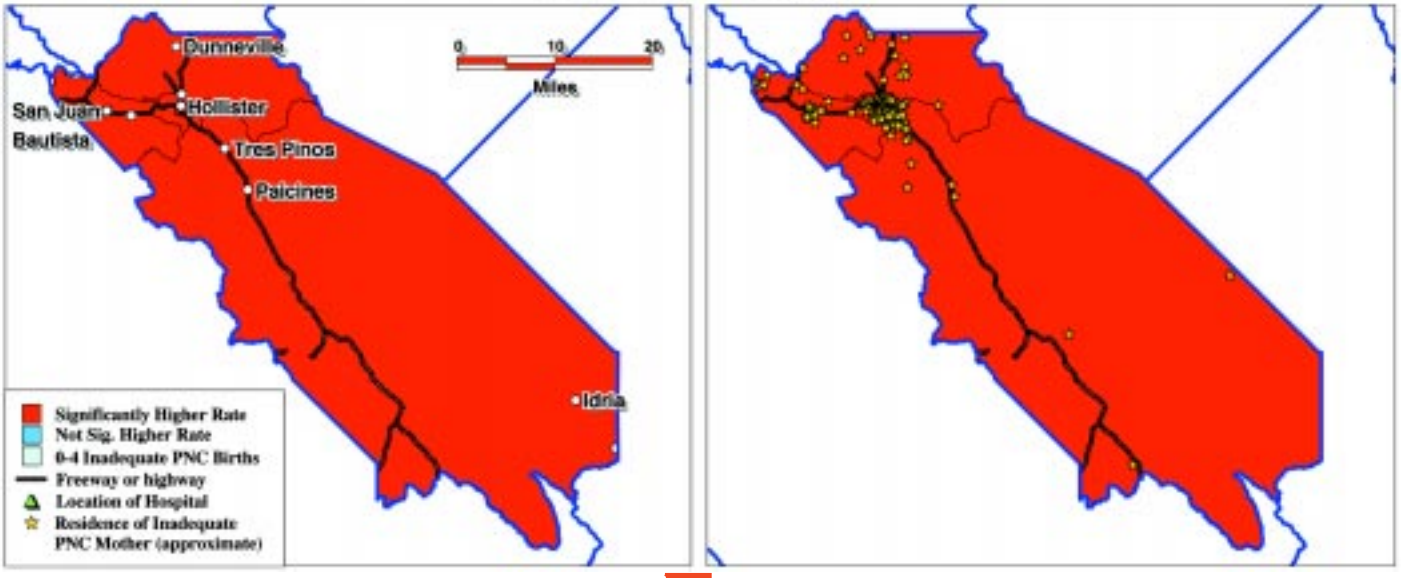
Sacramento County



Sacramento County (cont.)



San Benito County



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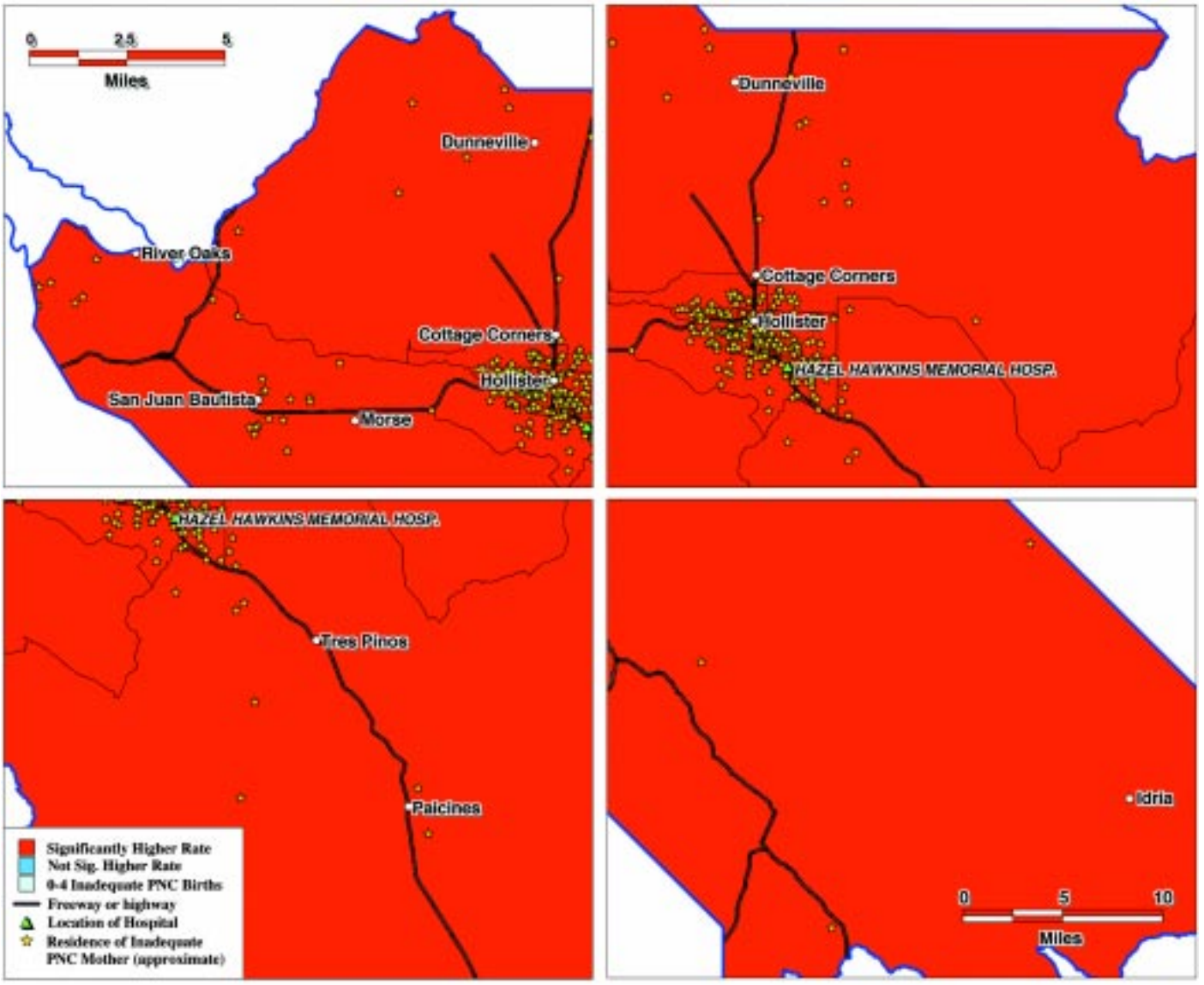
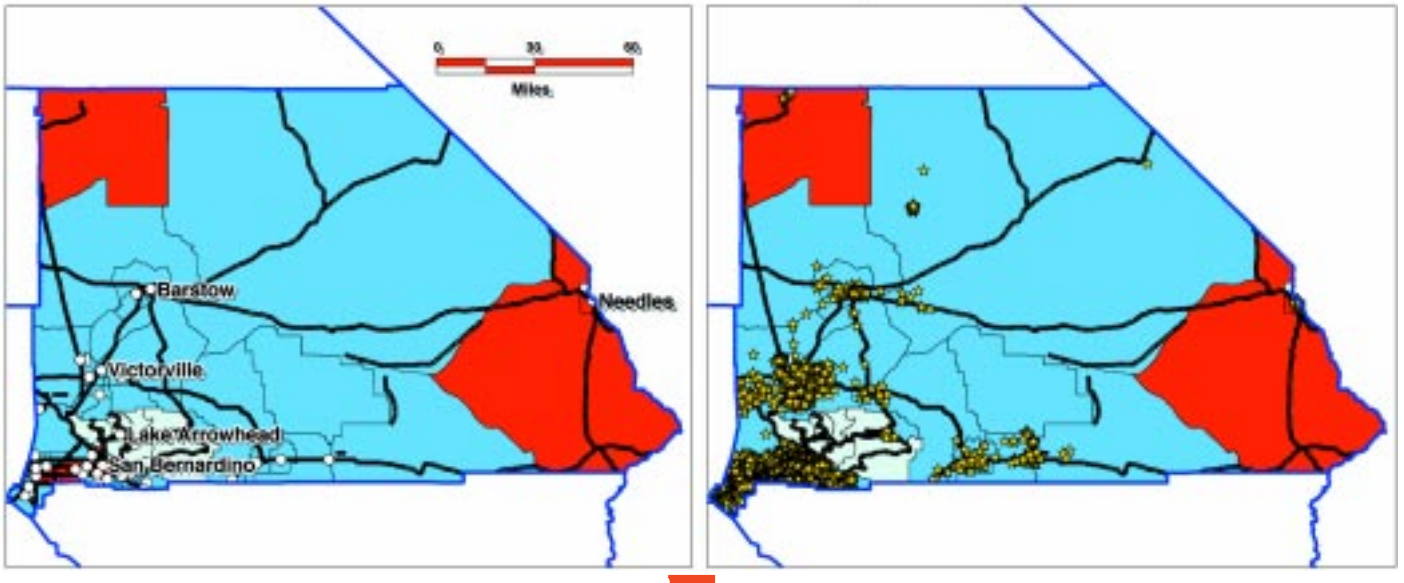


San Bernardino County



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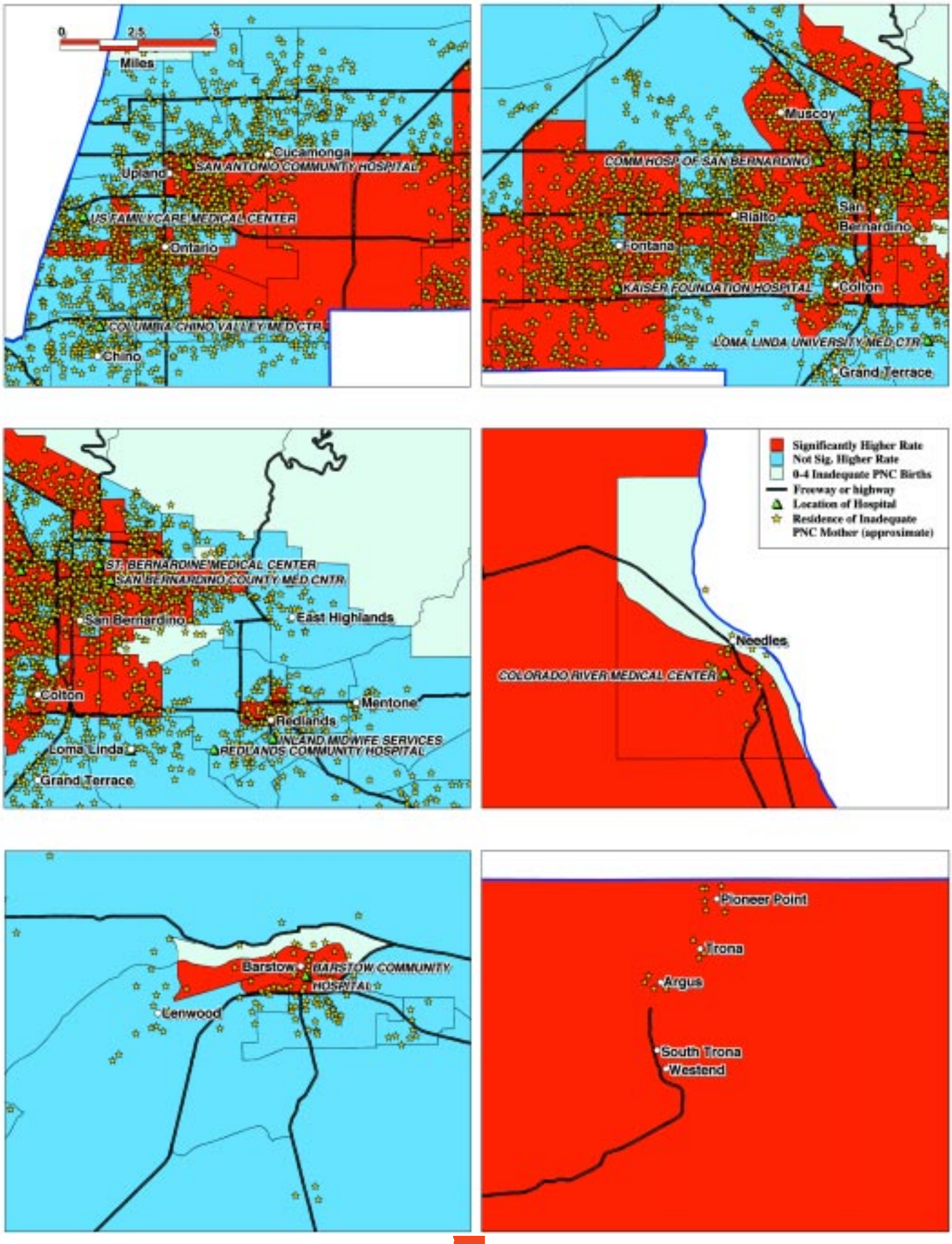
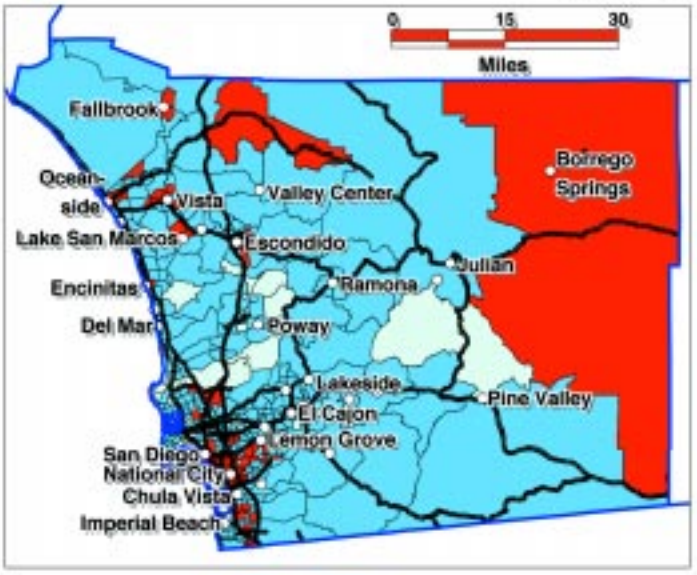
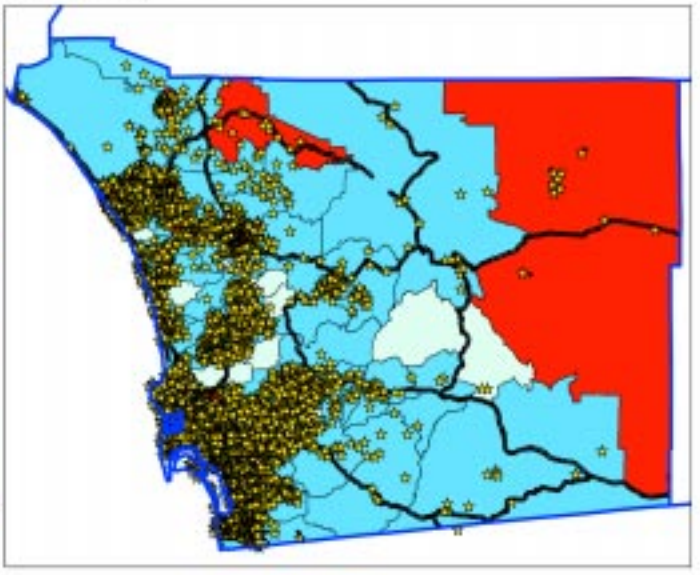
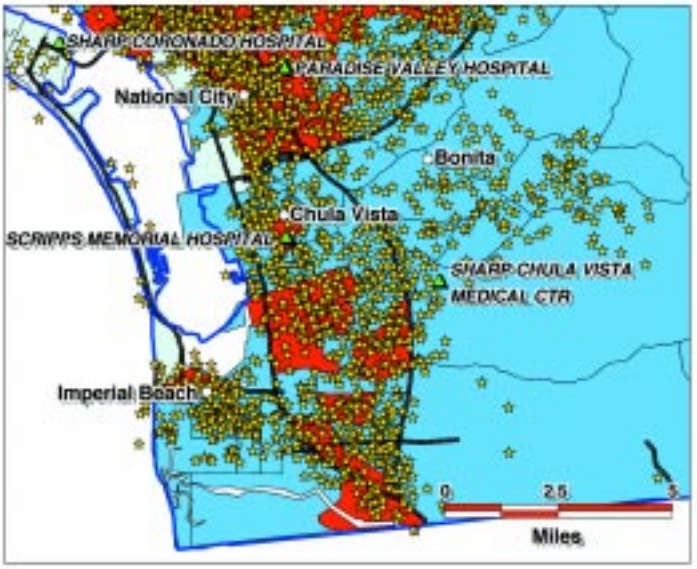
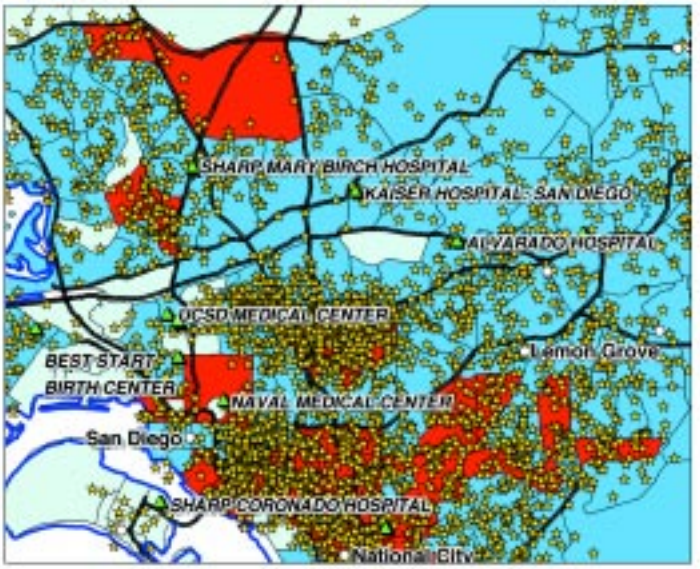


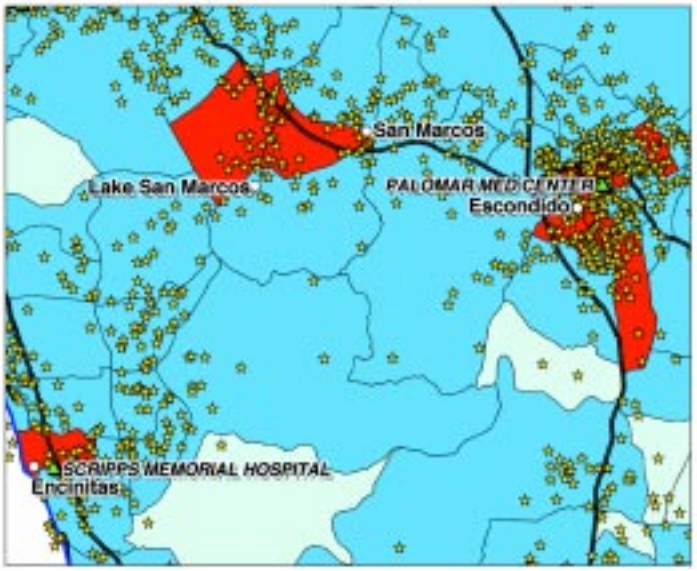
San Diego County

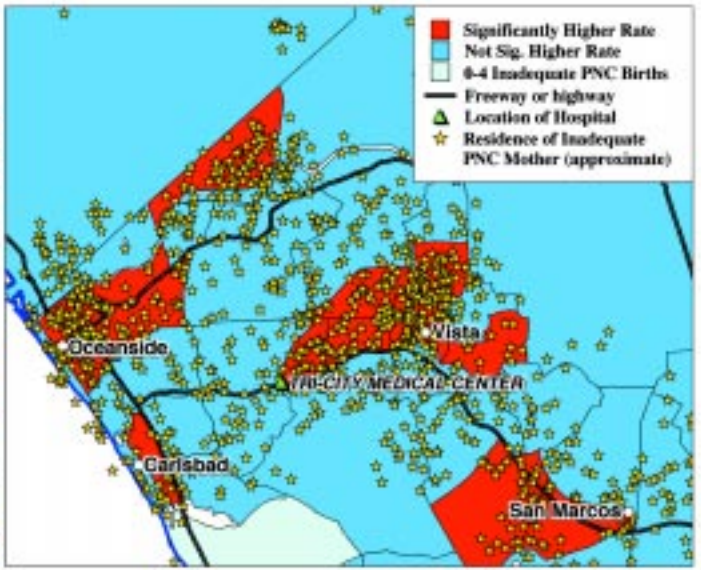












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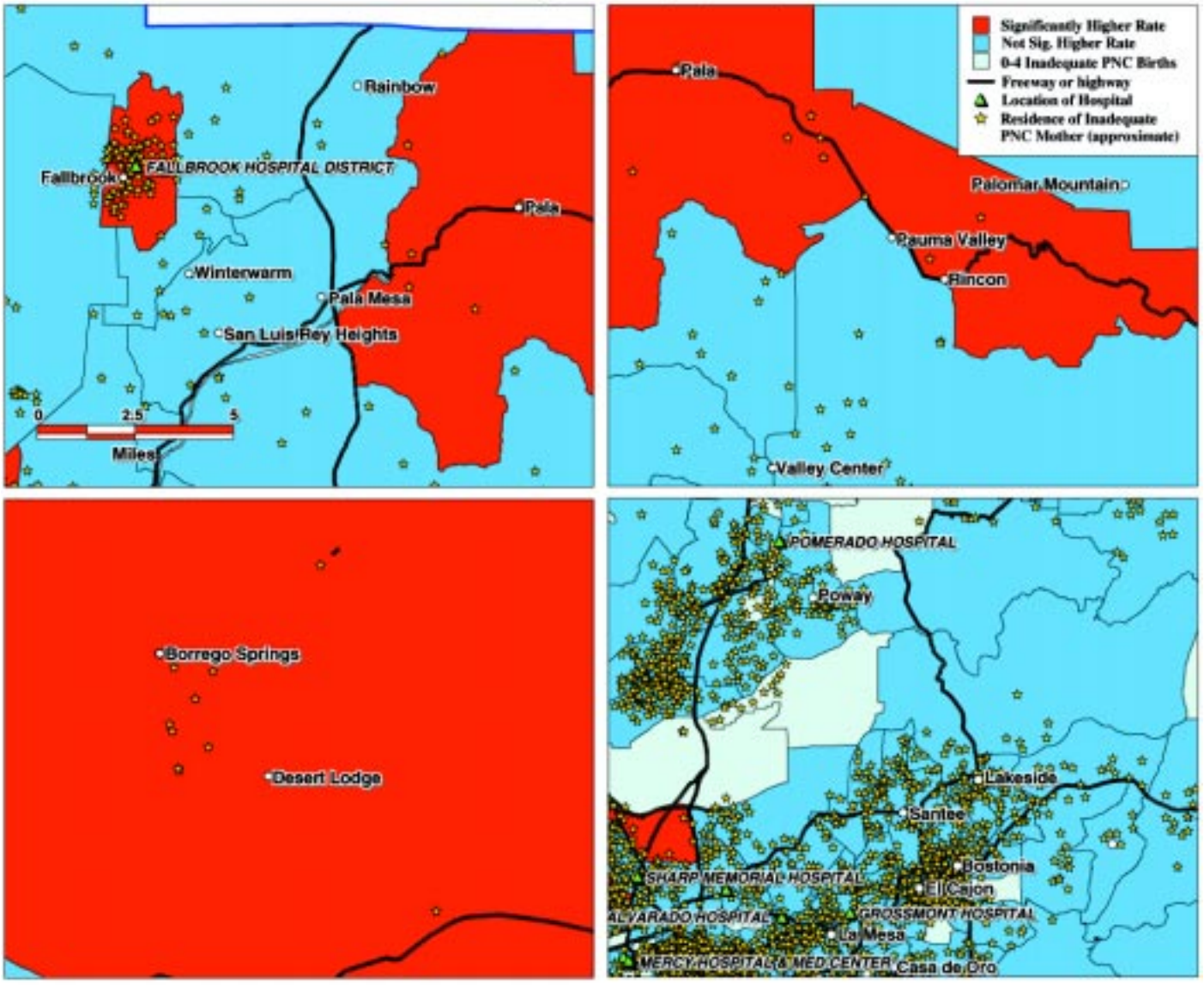
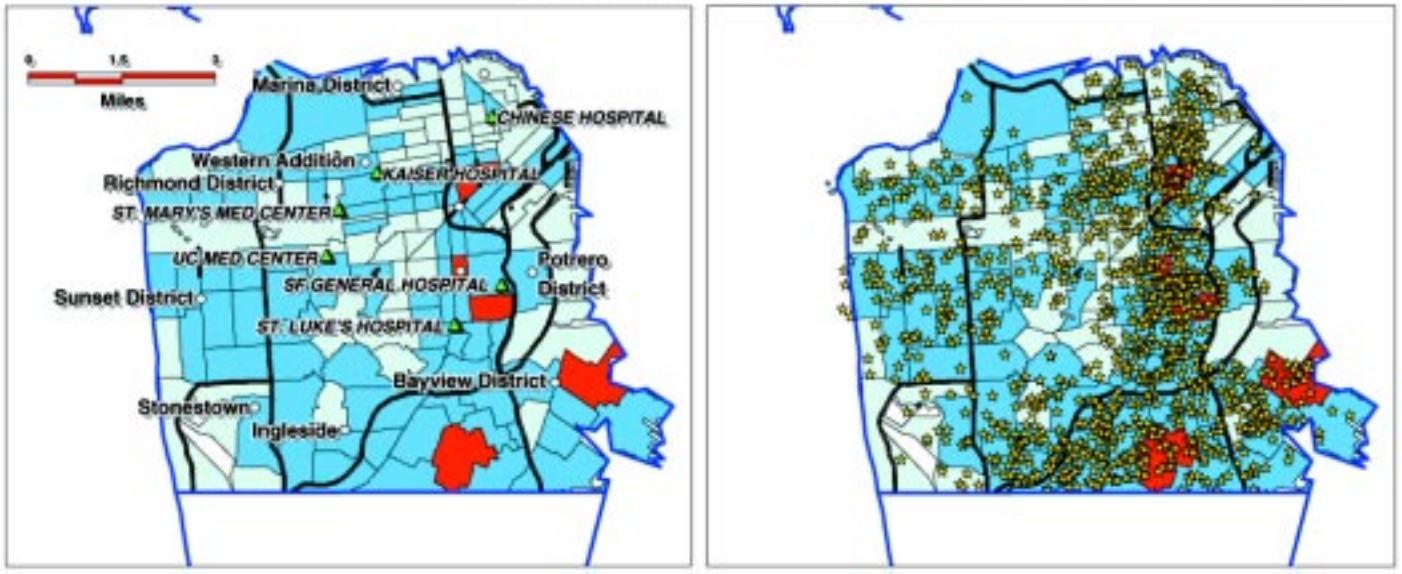
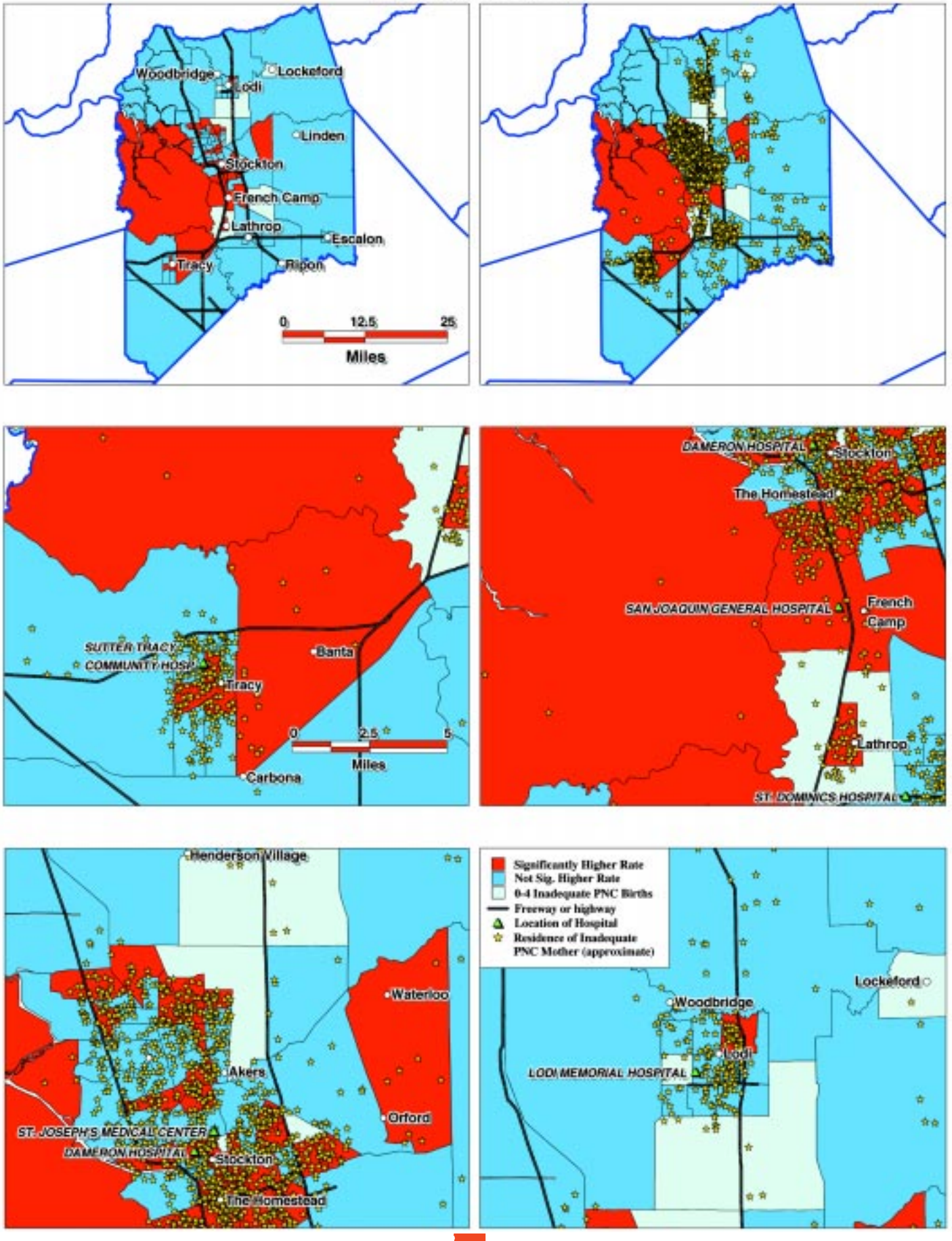


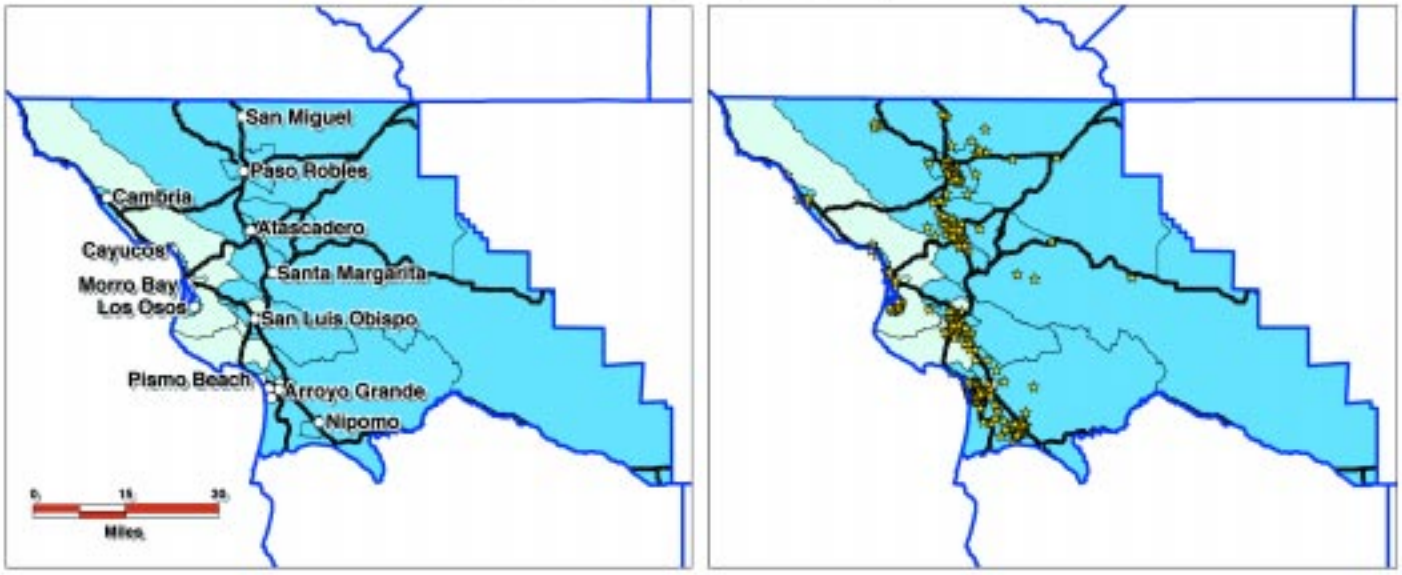
San Francisco County



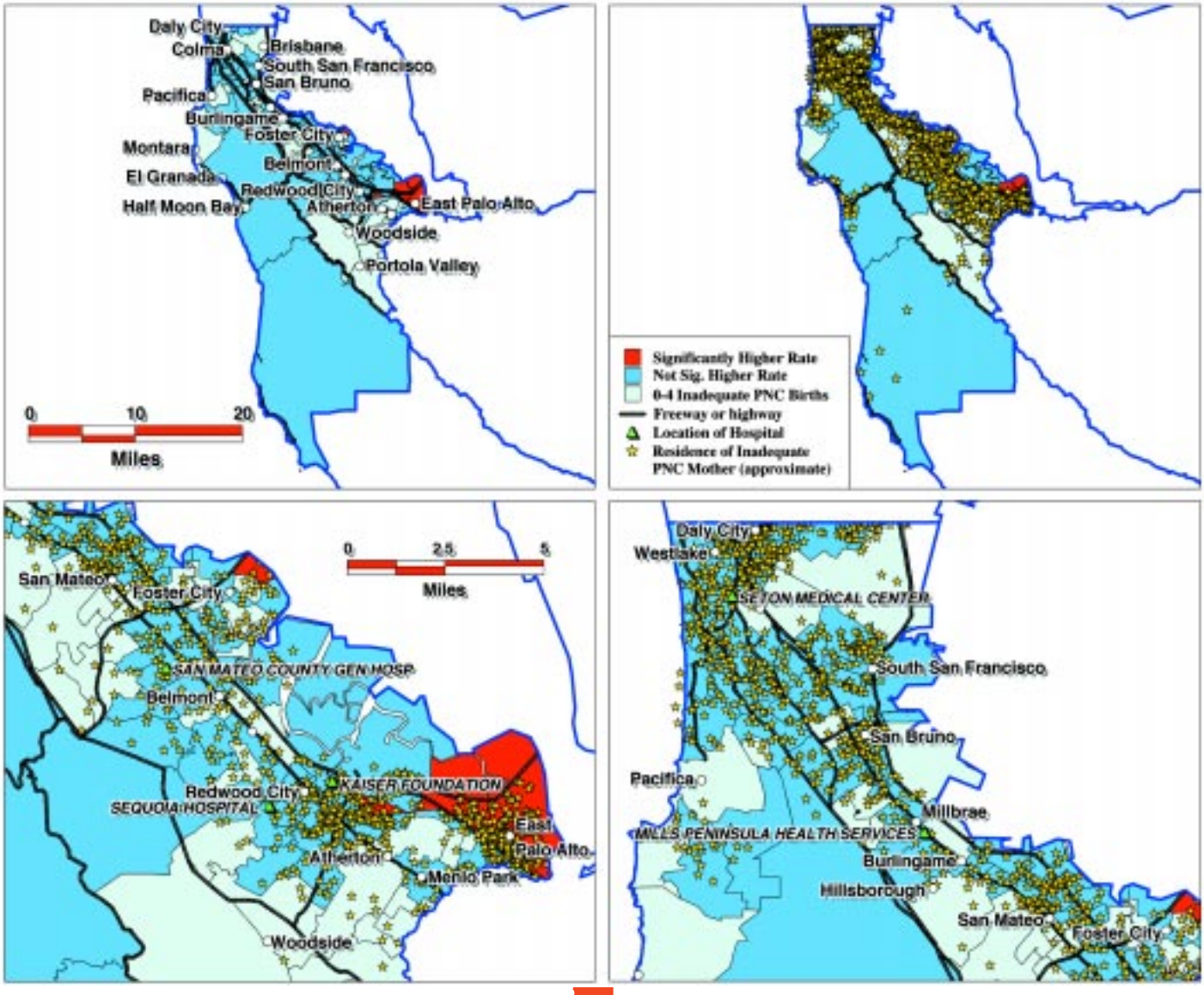
San Joaquin County



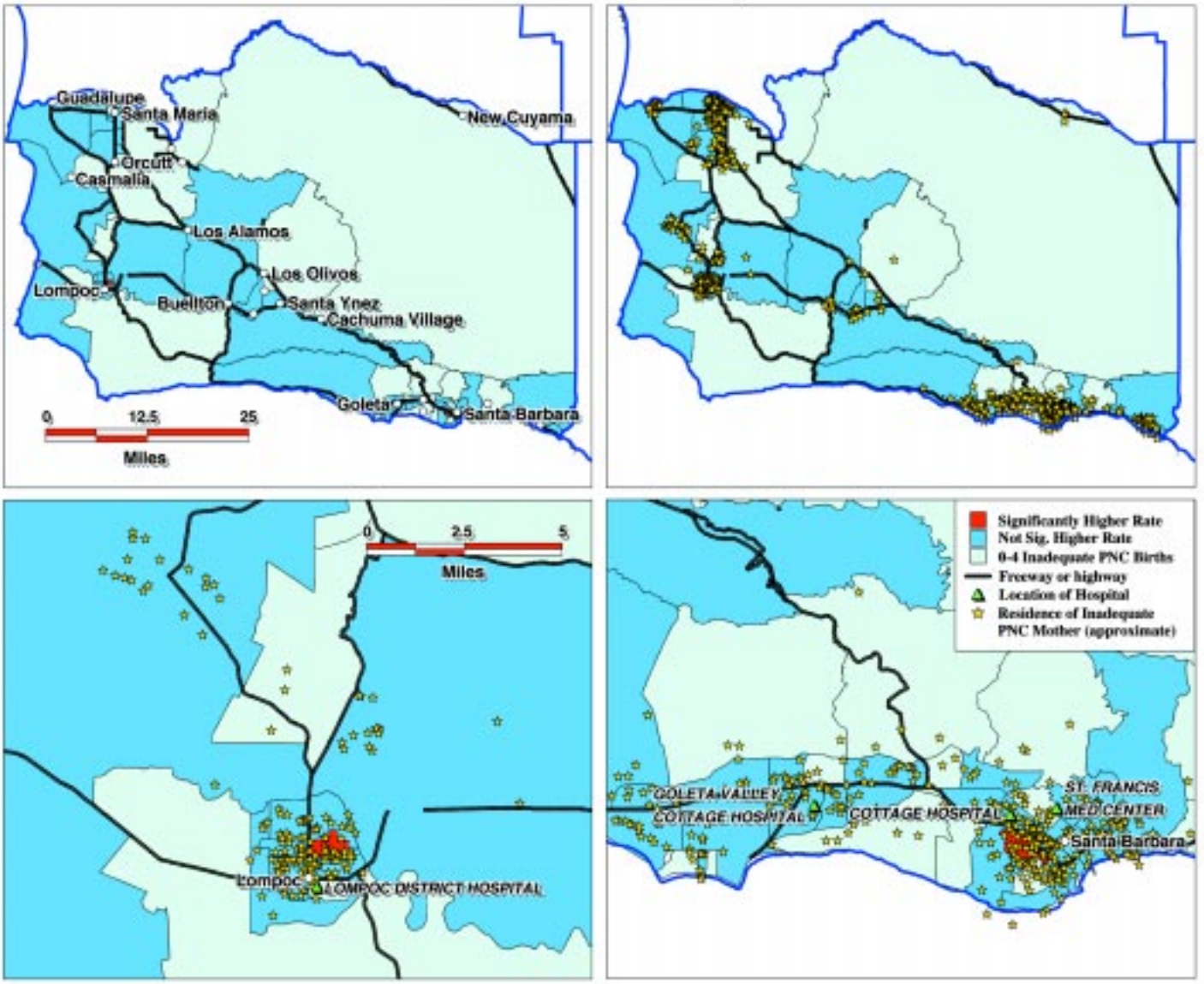
San Luis Obispo County



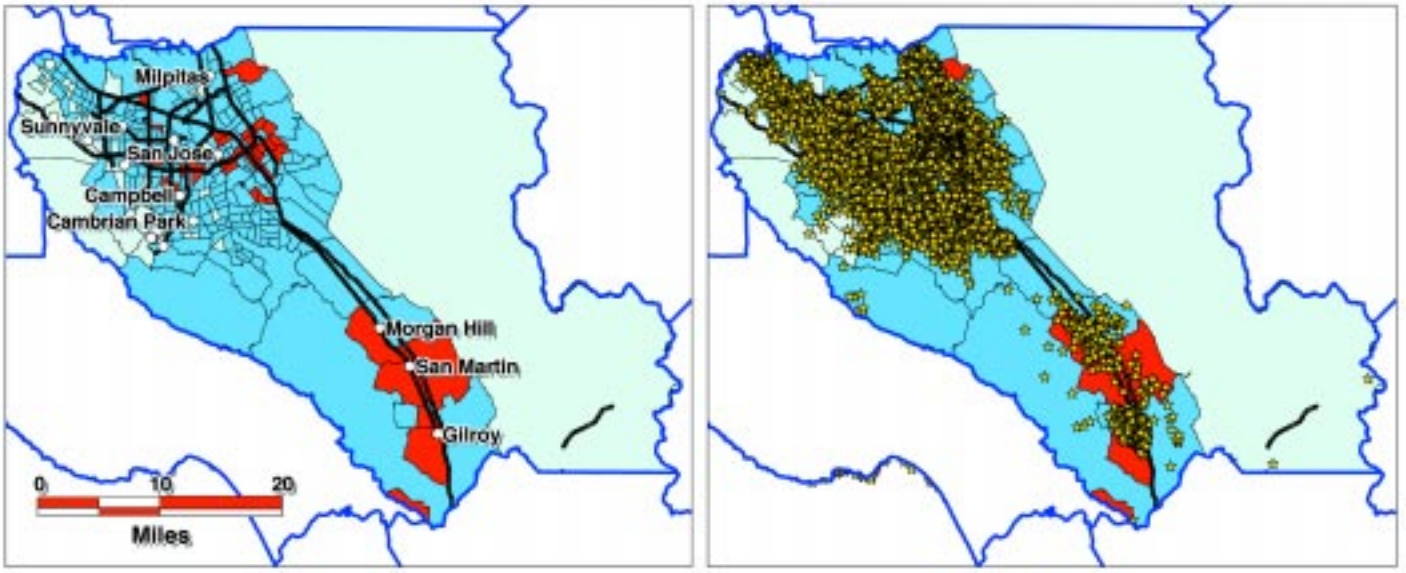
San Mateo County



Santa Barbara County



Santa Clara County



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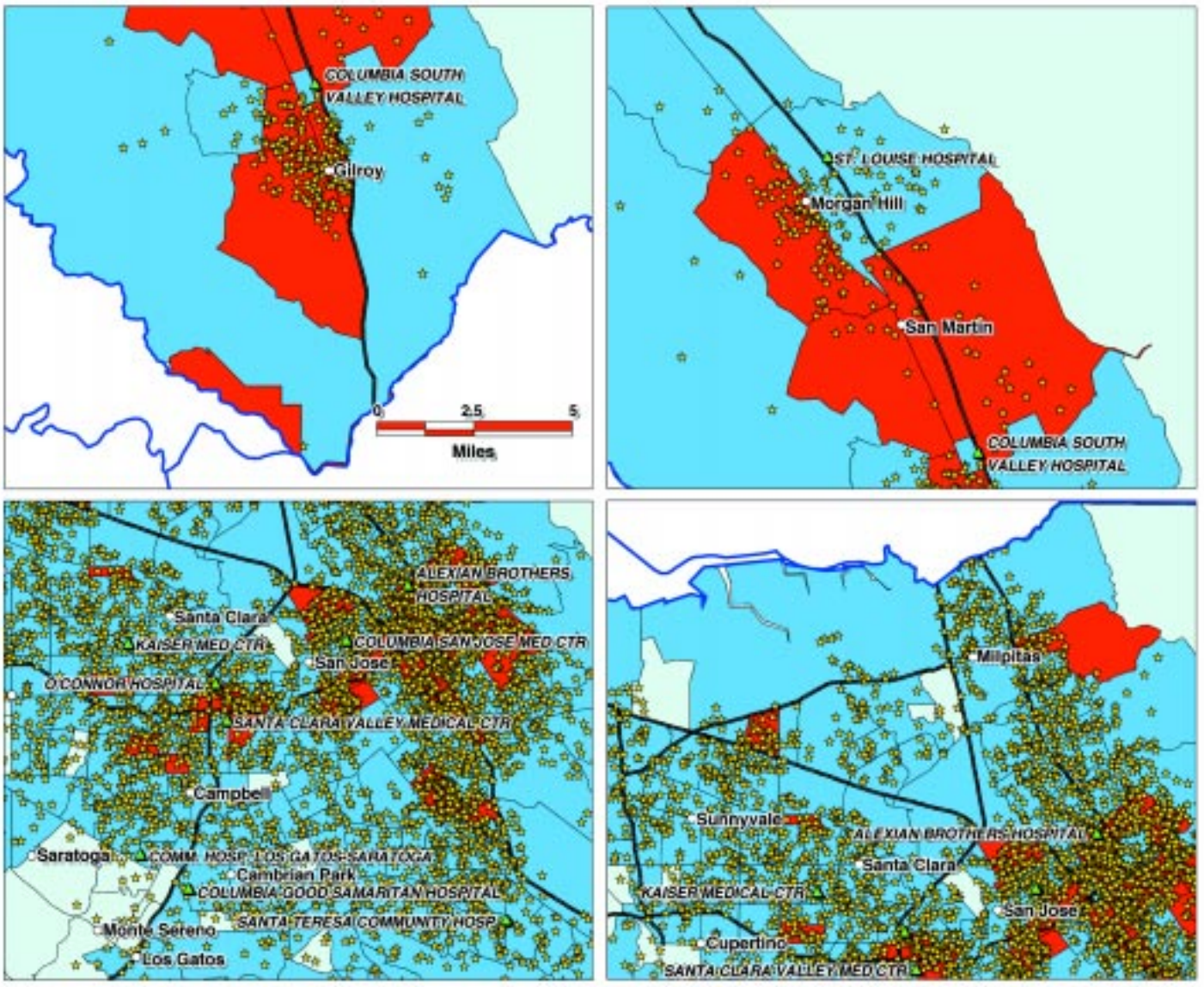
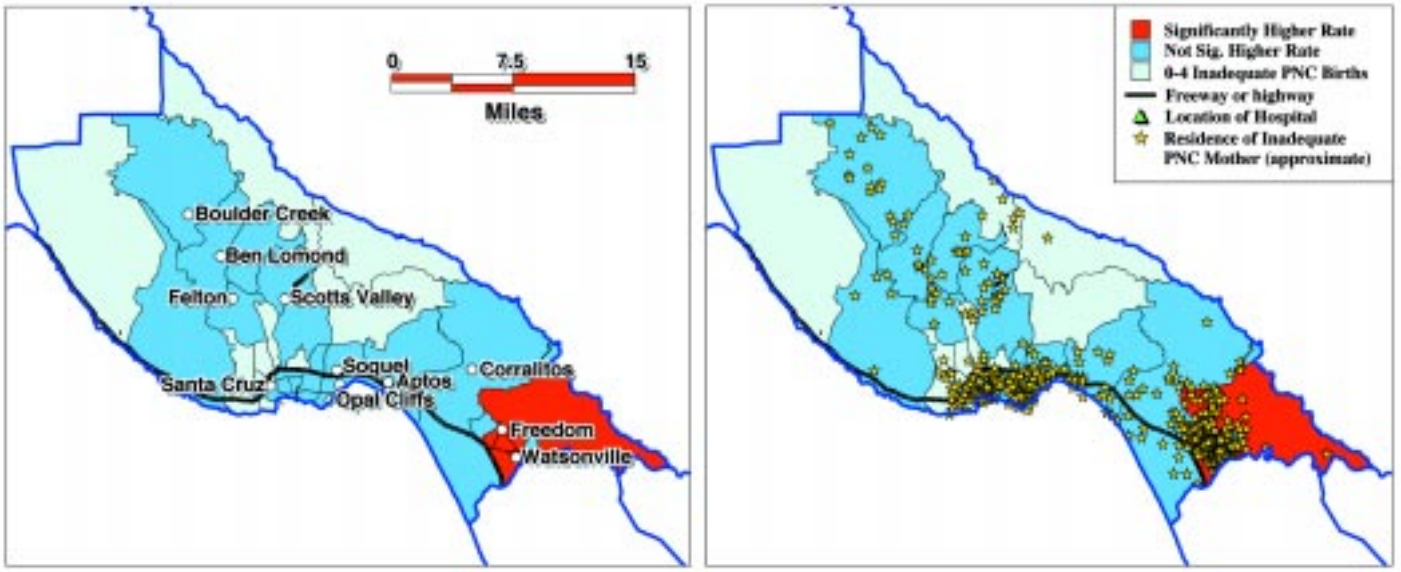
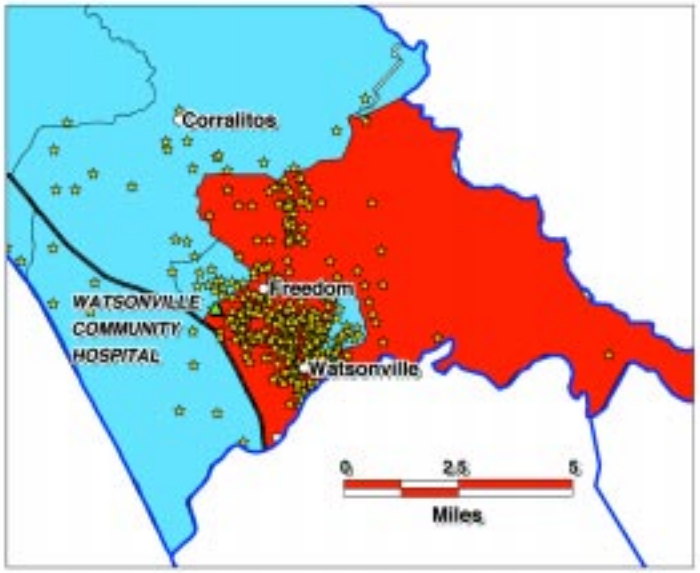
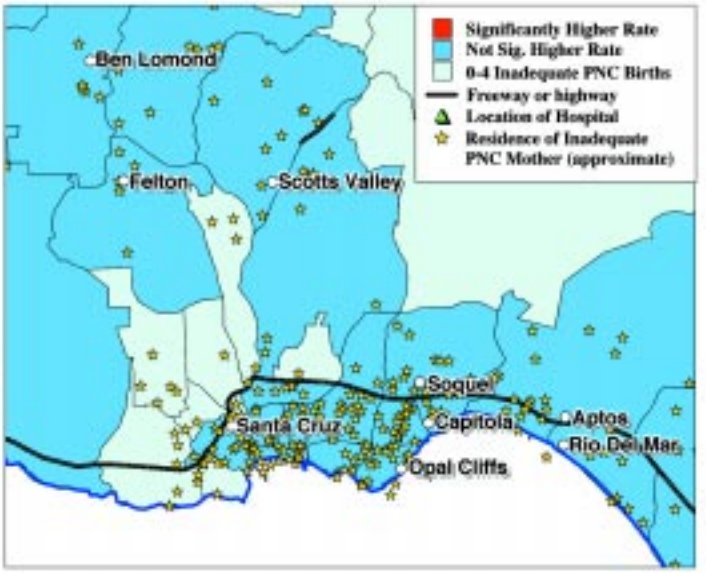


Santa Cruz County

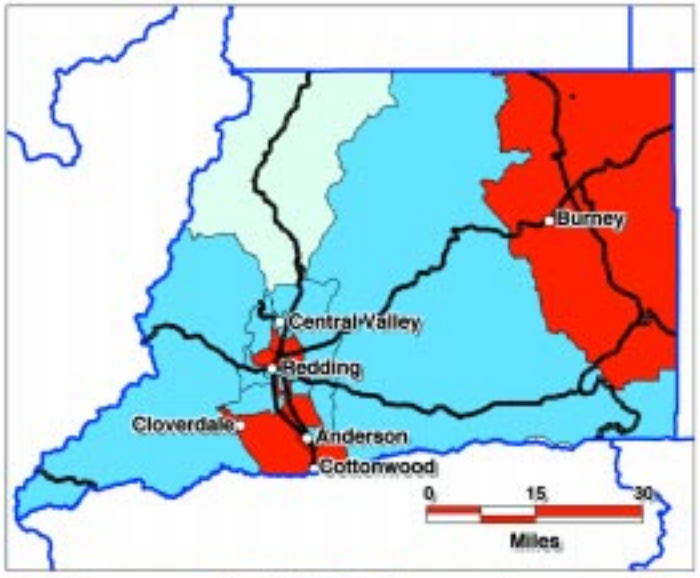


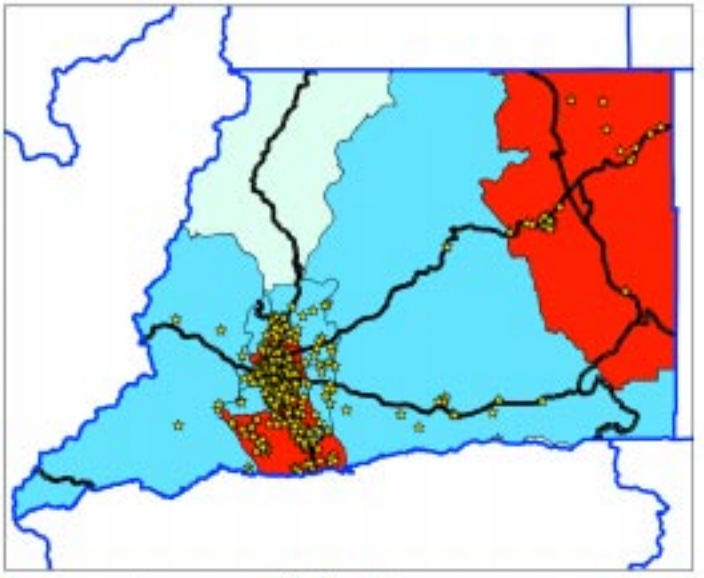
Santa Cruz County (cont.)

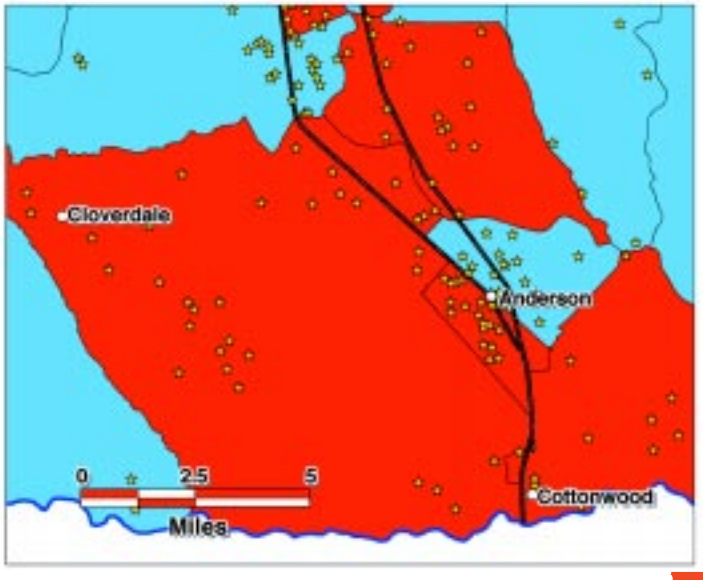


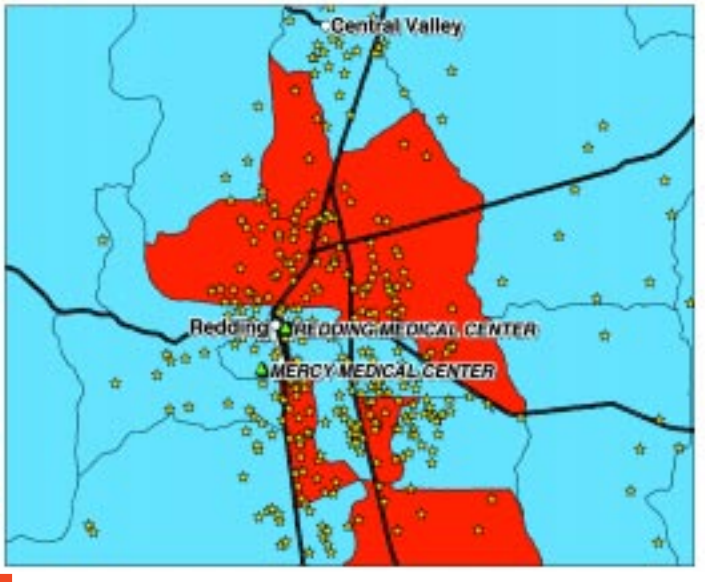


Shasta County

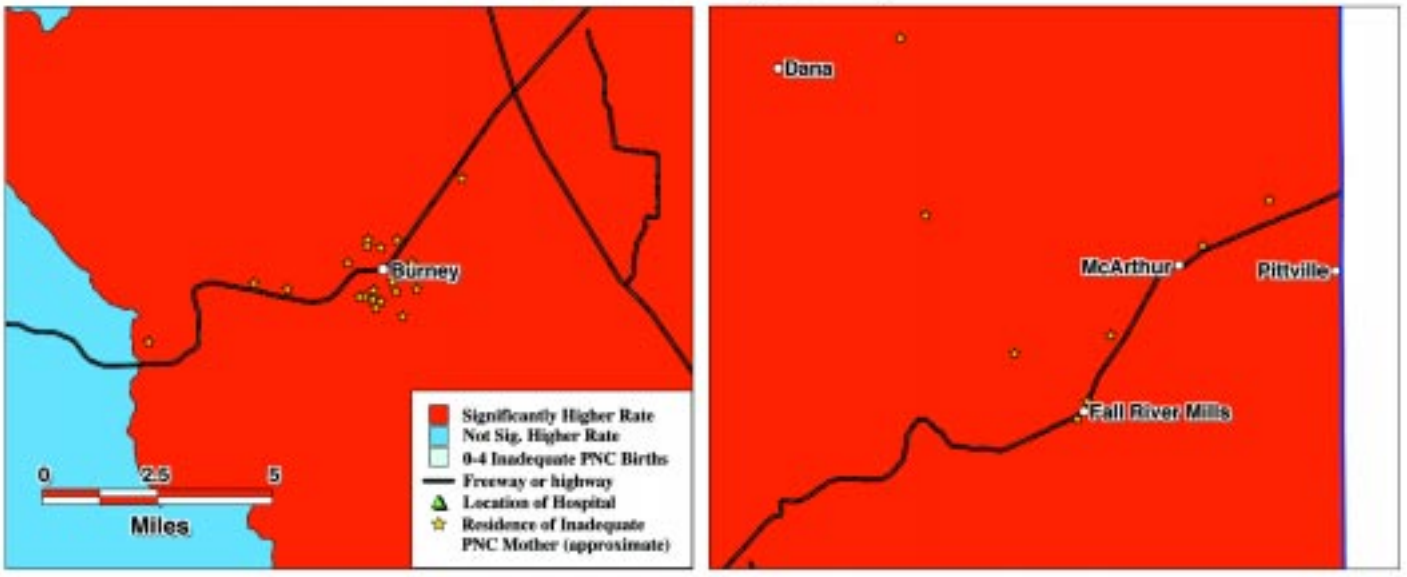




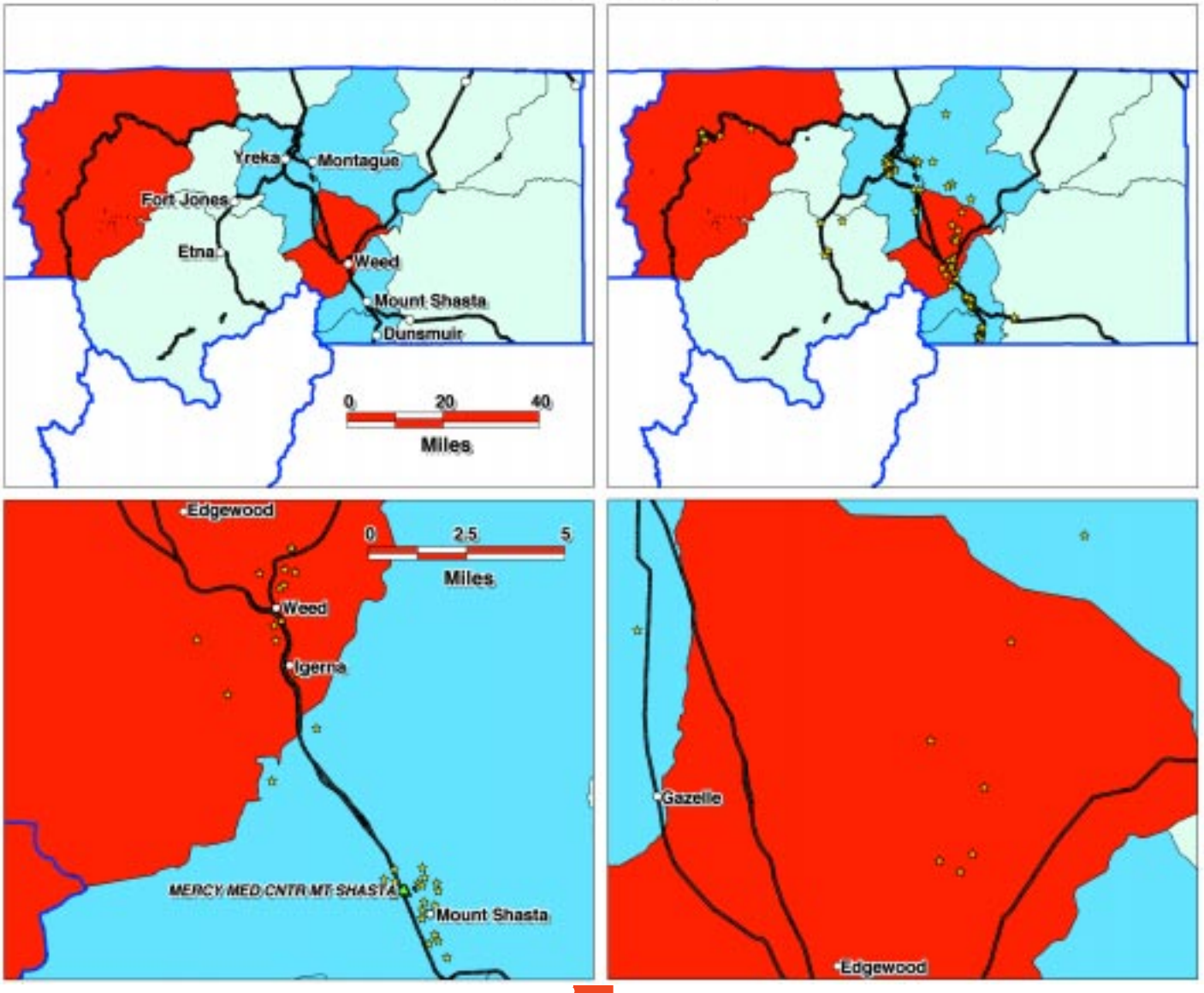




Shasta County (cont.)



Siskiyou County



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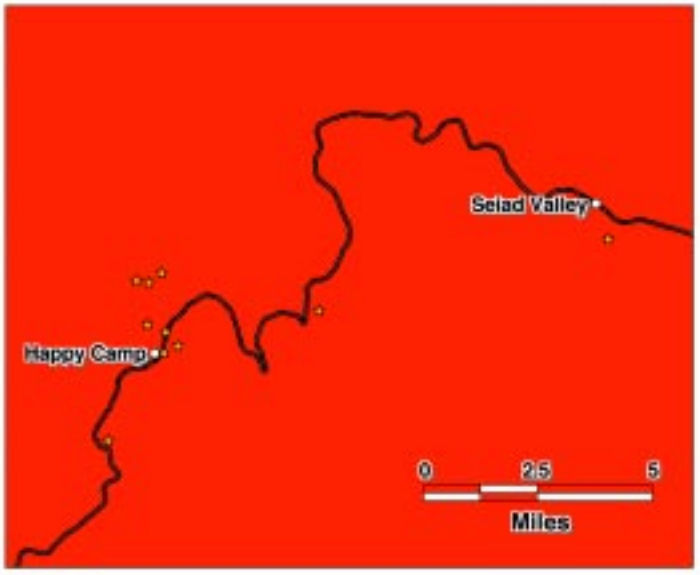
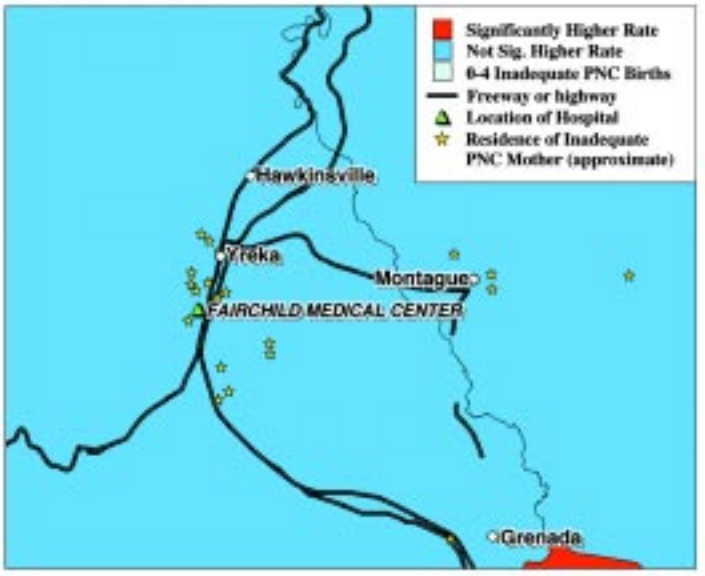
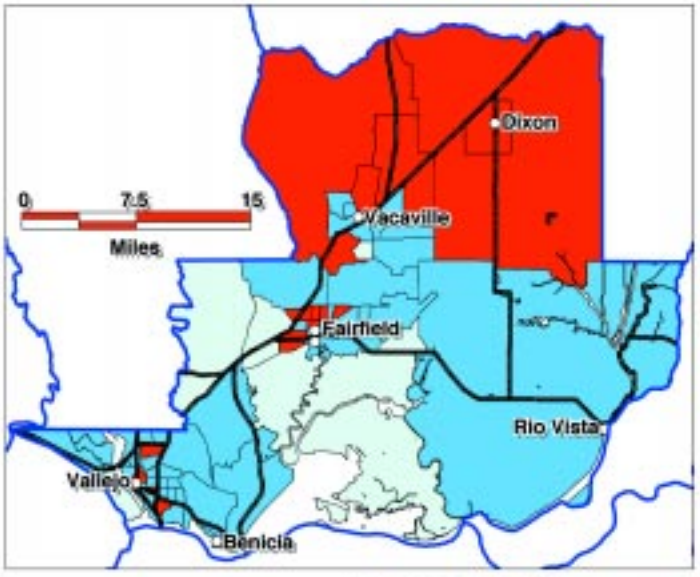
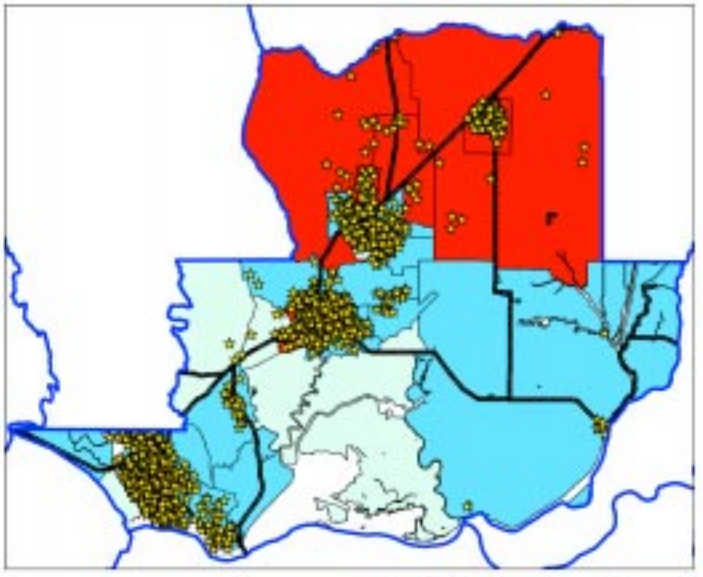
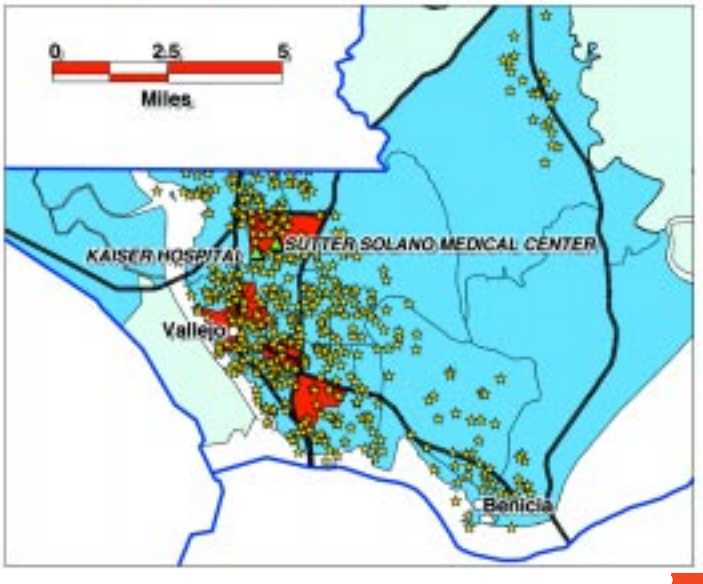


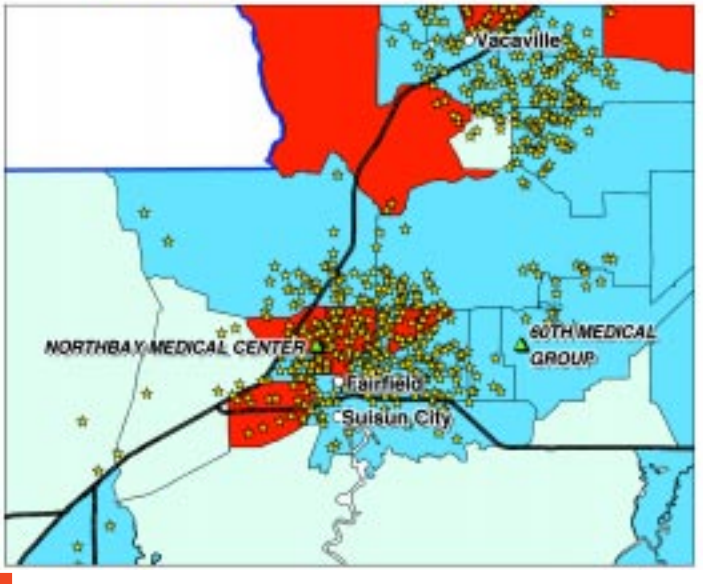


Solano County









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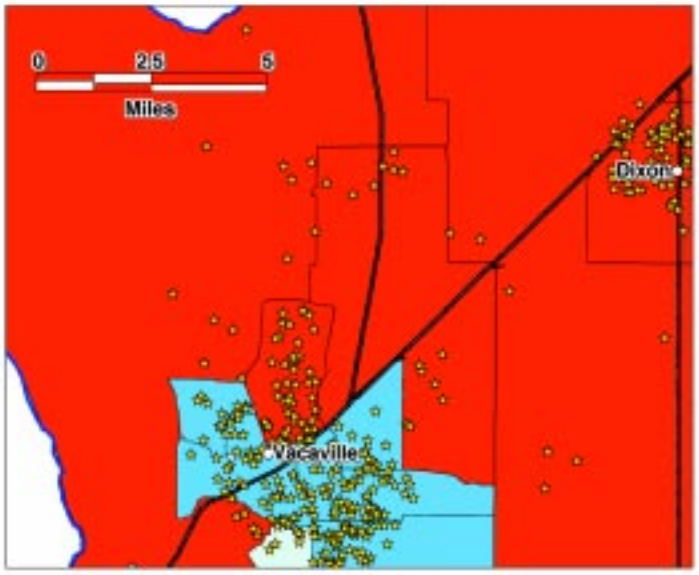
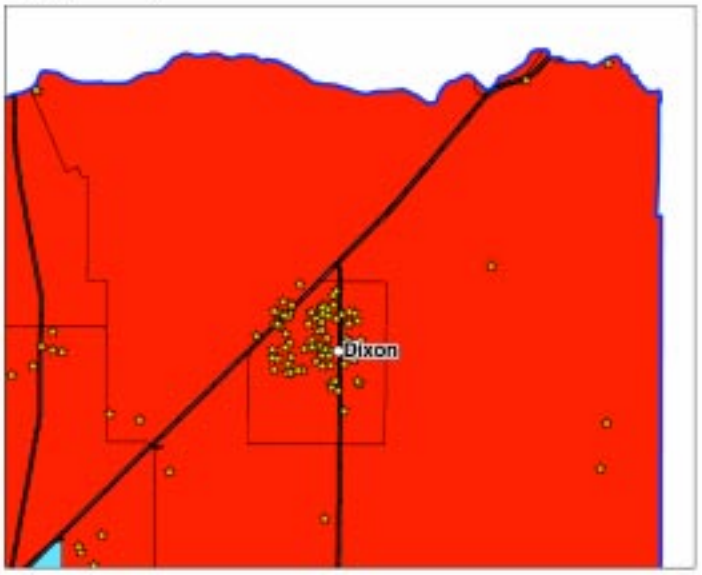
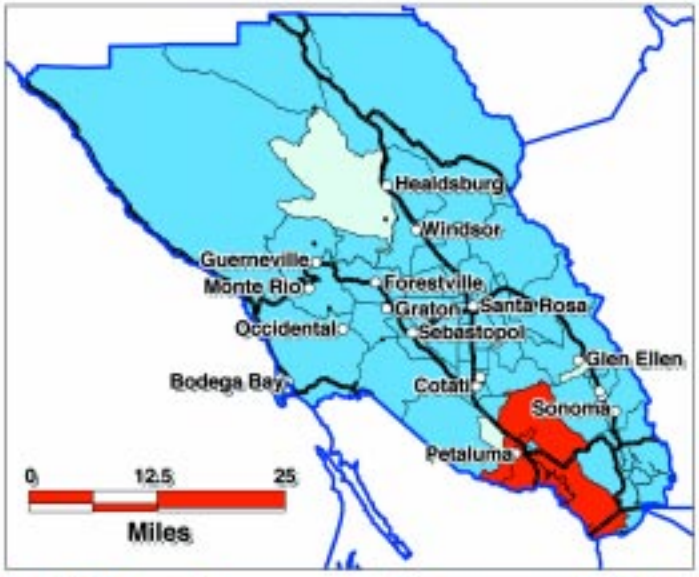
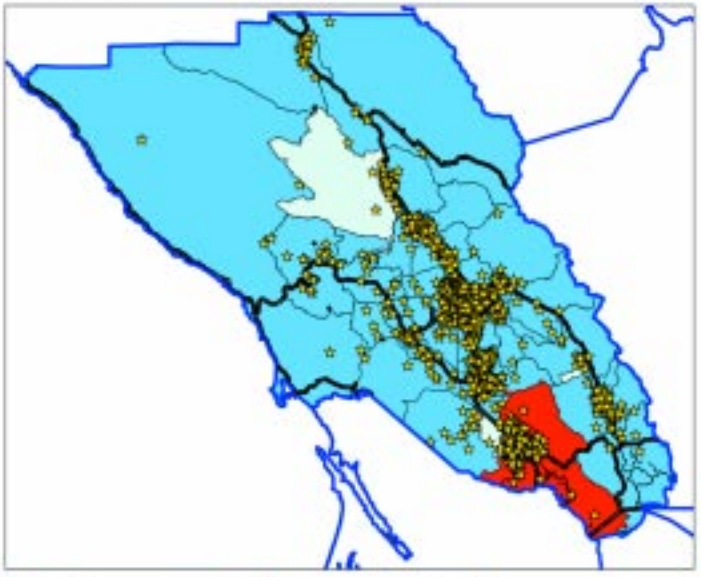
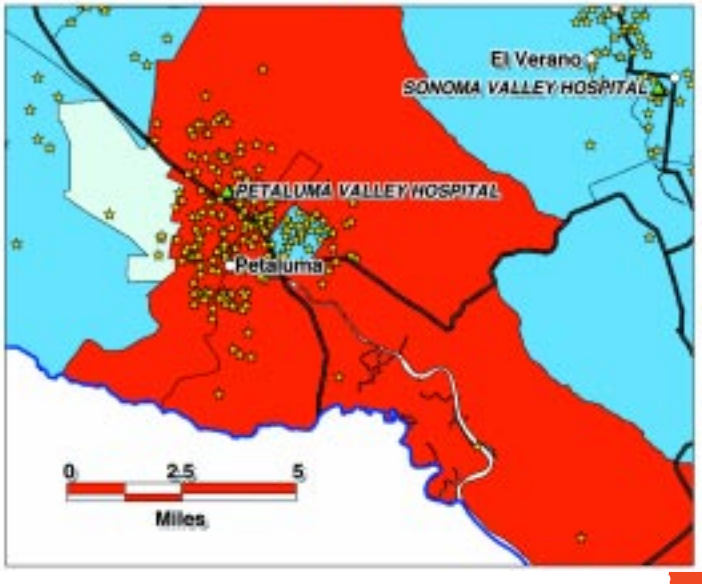




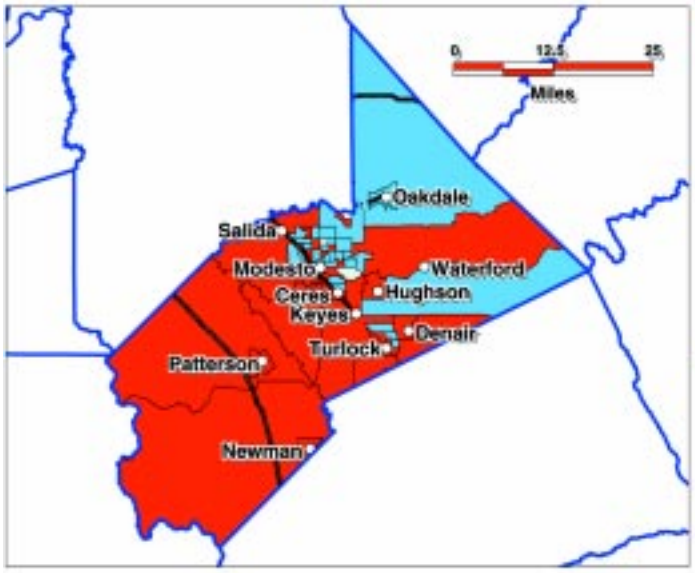
Sonoma County

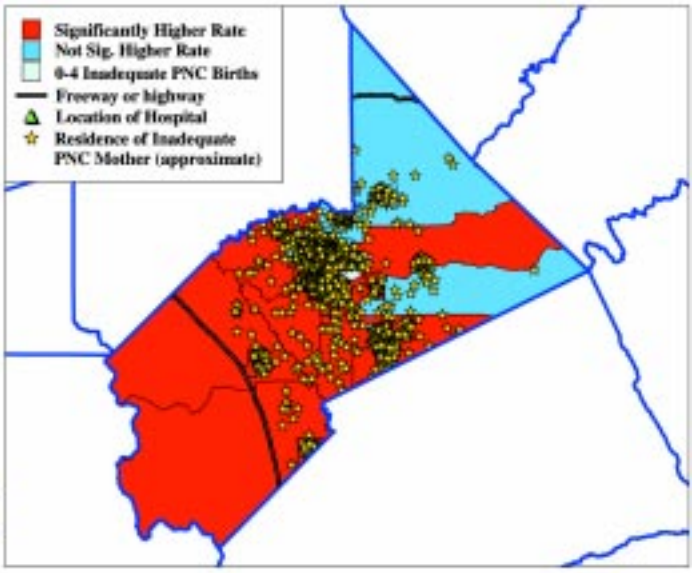


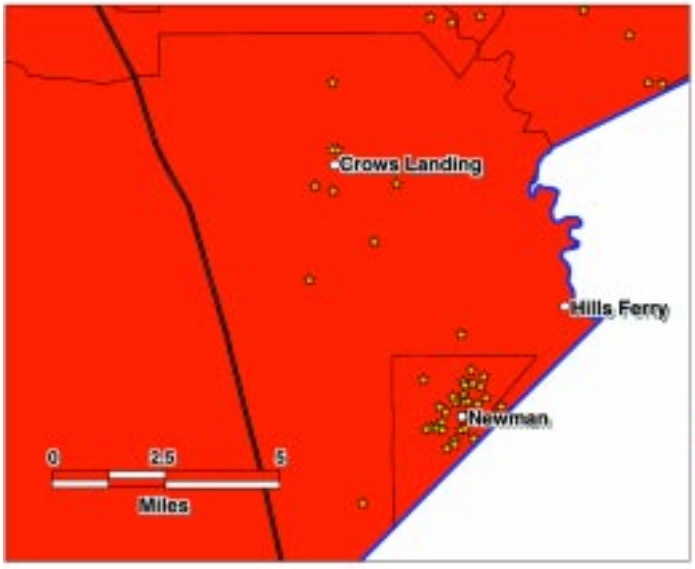


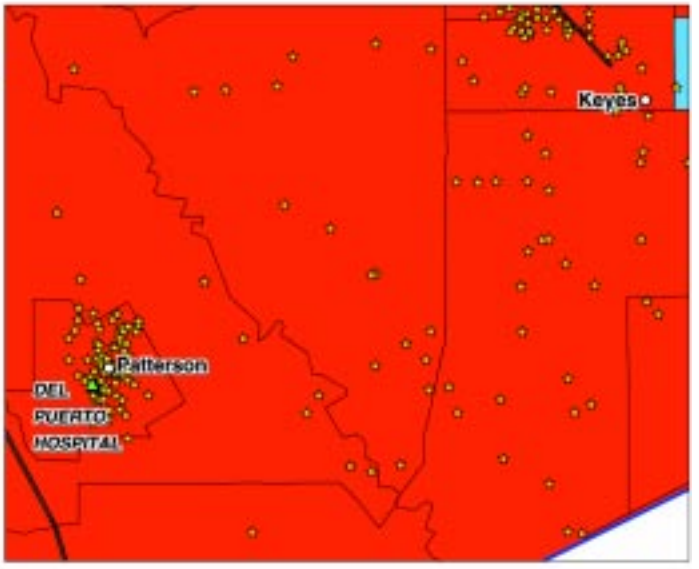


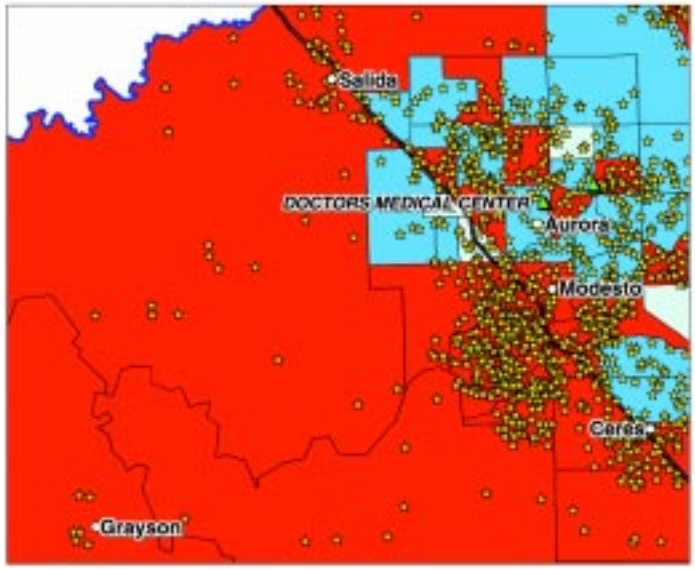
Stanislaus County

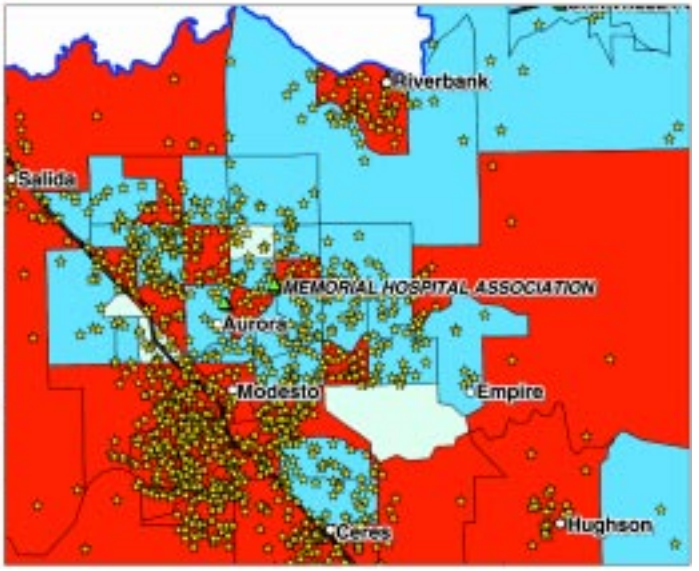




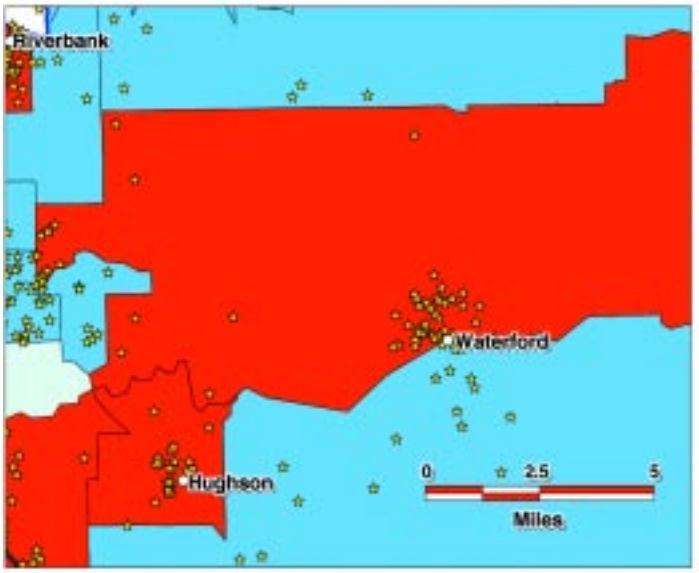


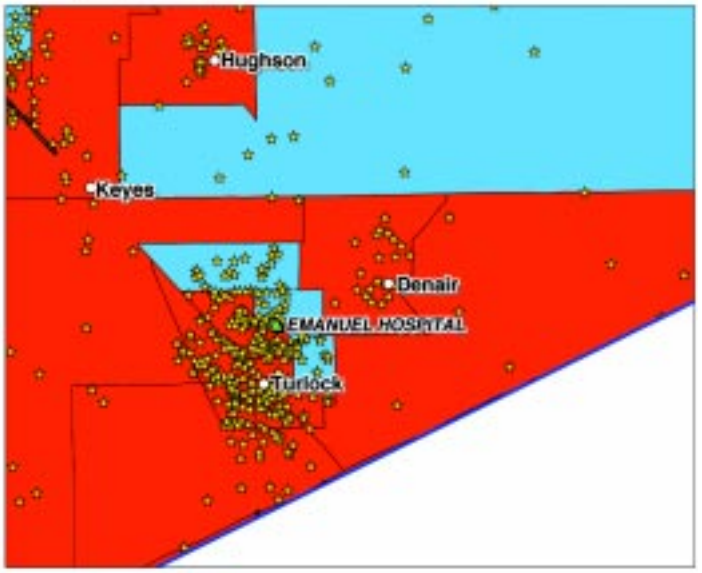




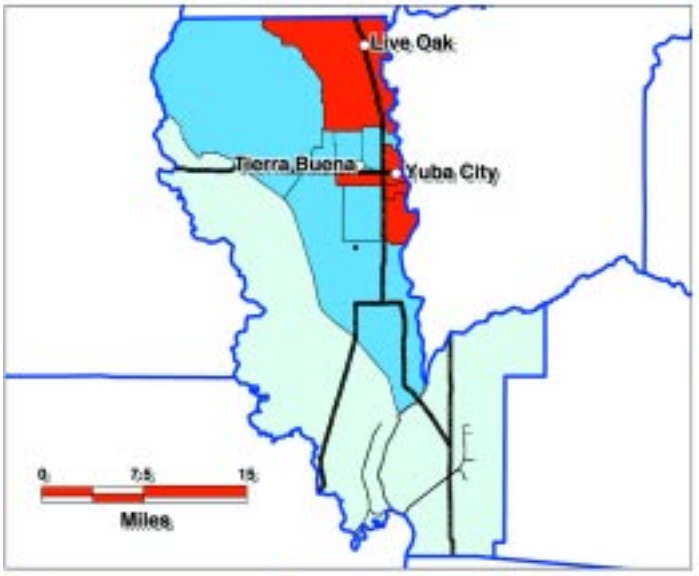


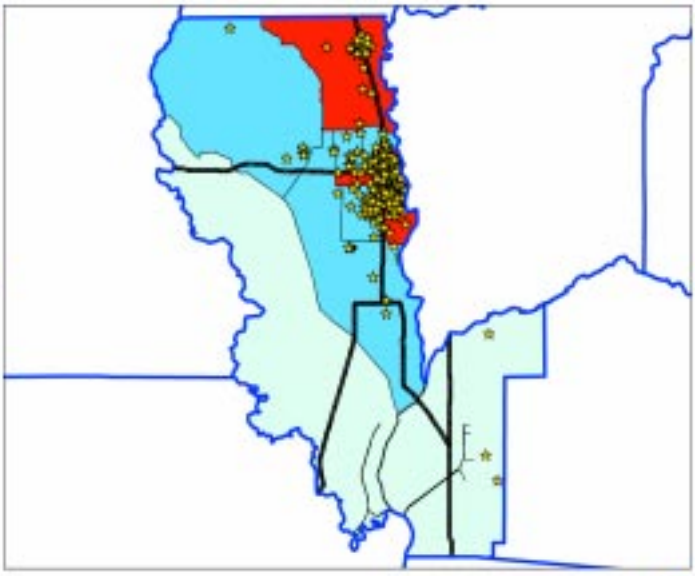
Stanislaus County (cont.)

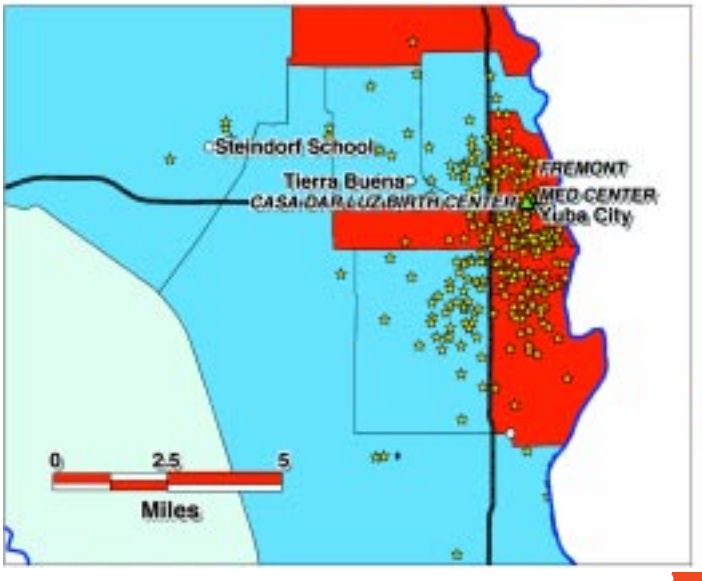


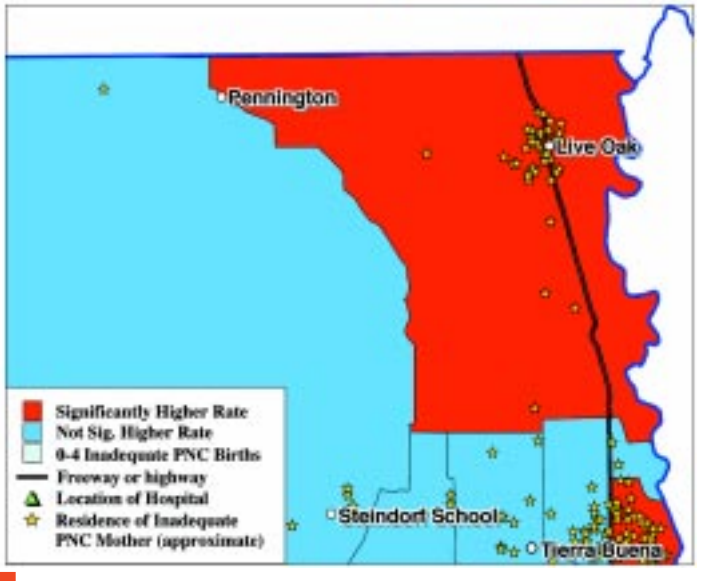


Sutter County

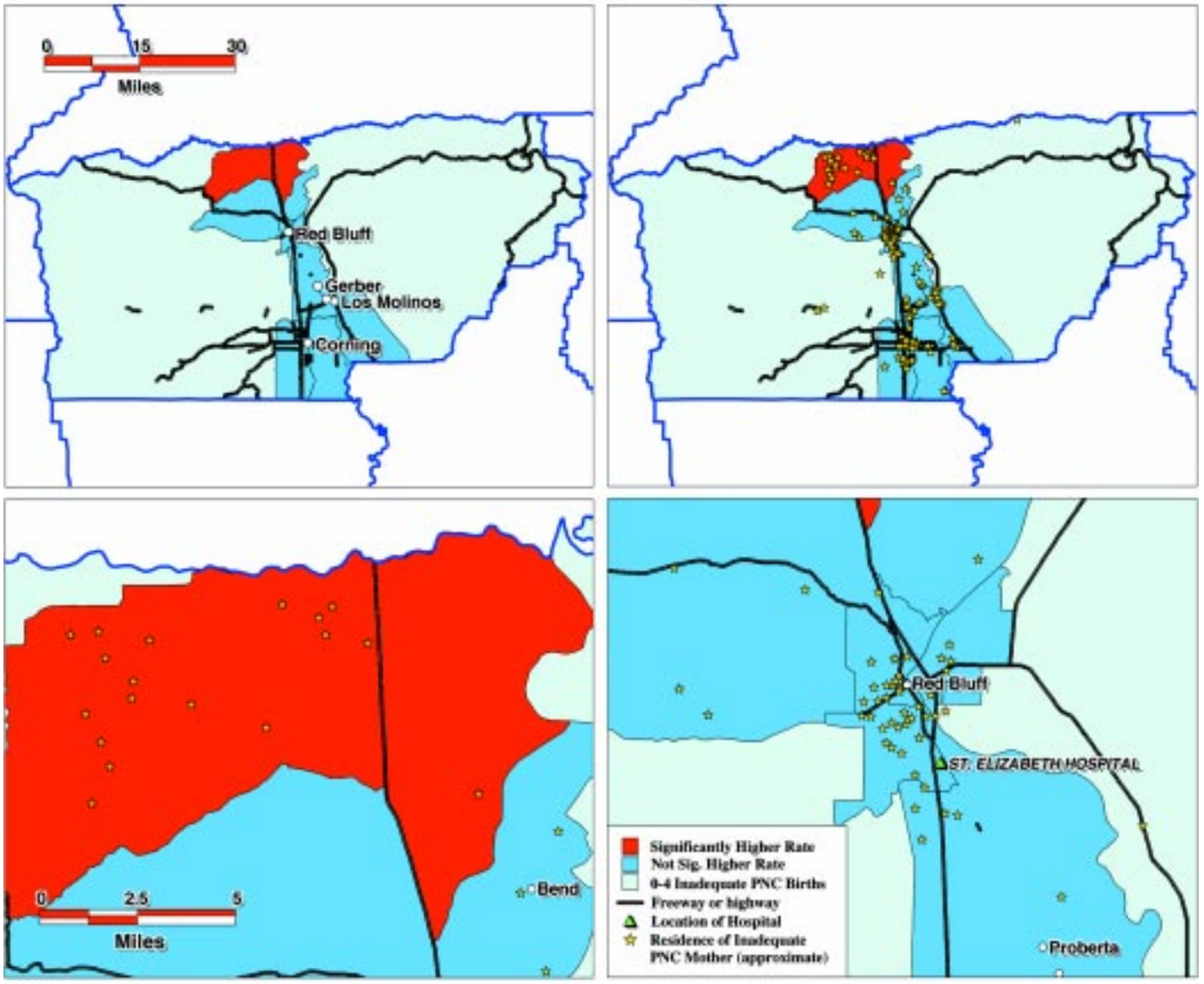




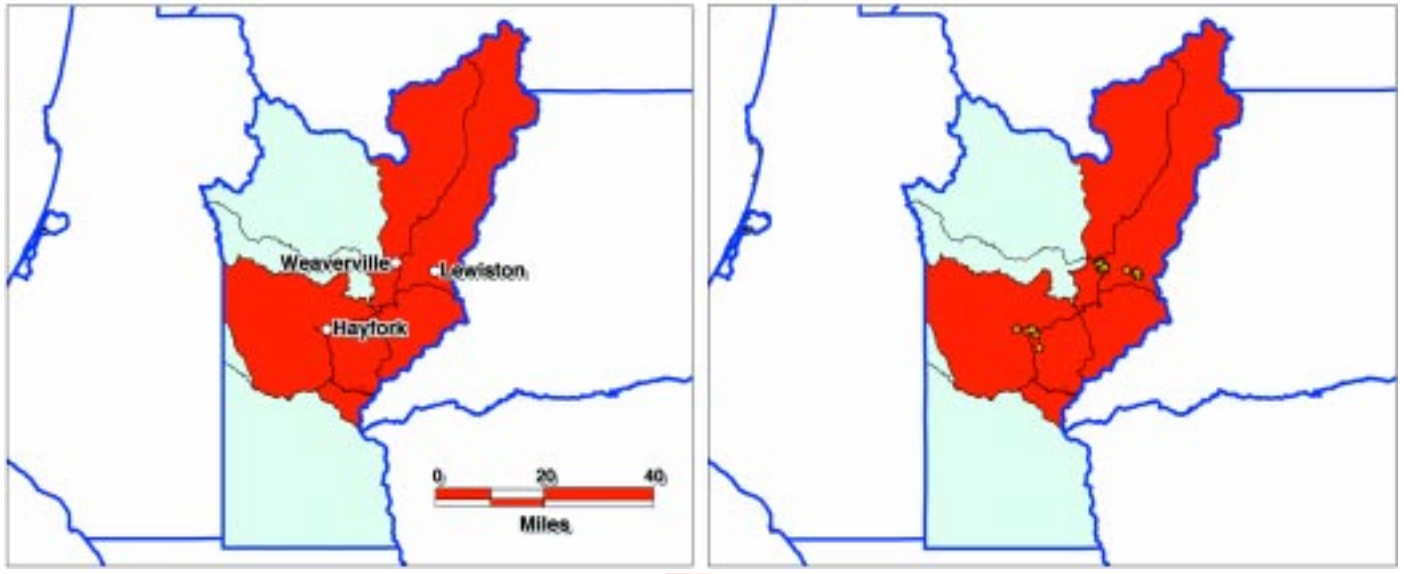




Tehama County



Trinity County



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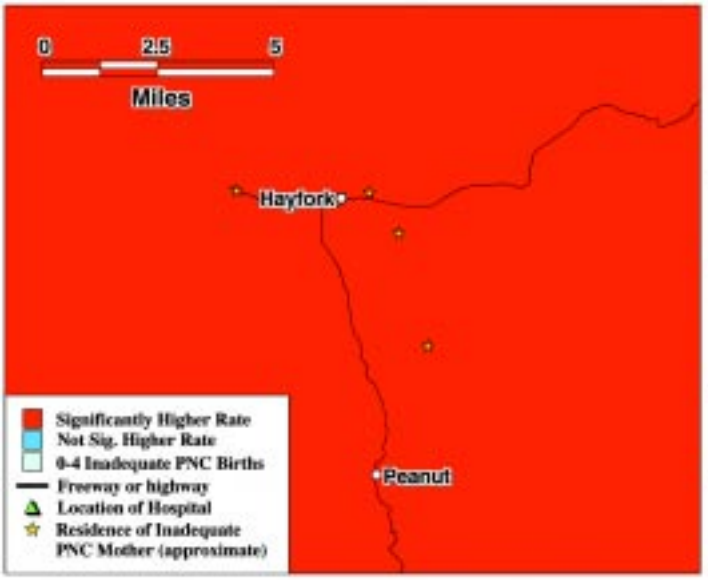
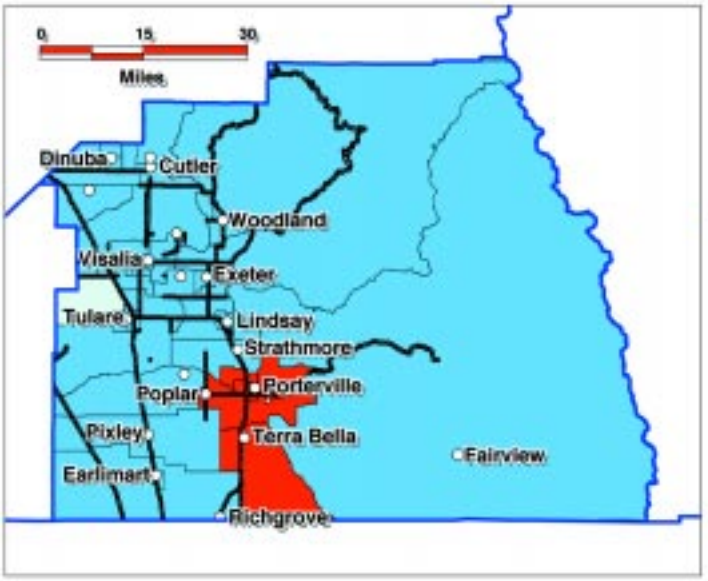
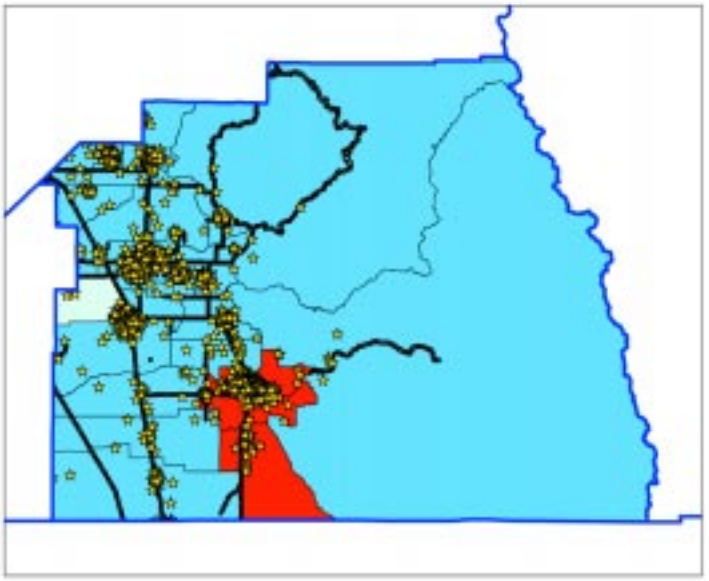
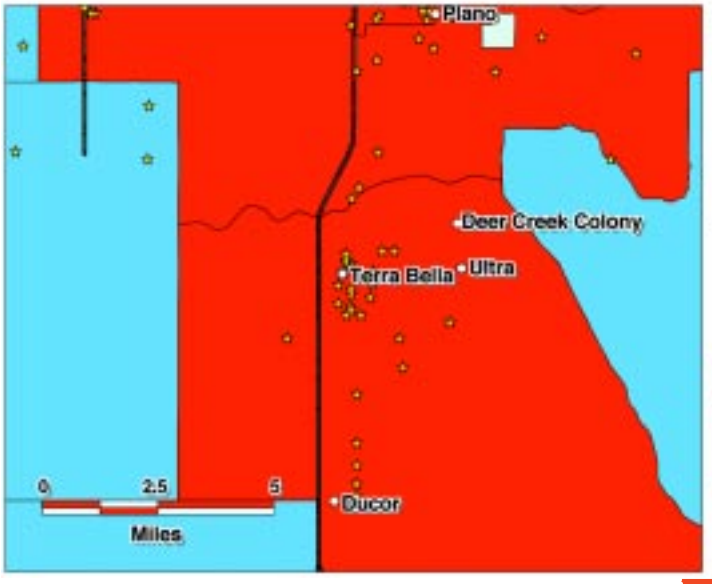
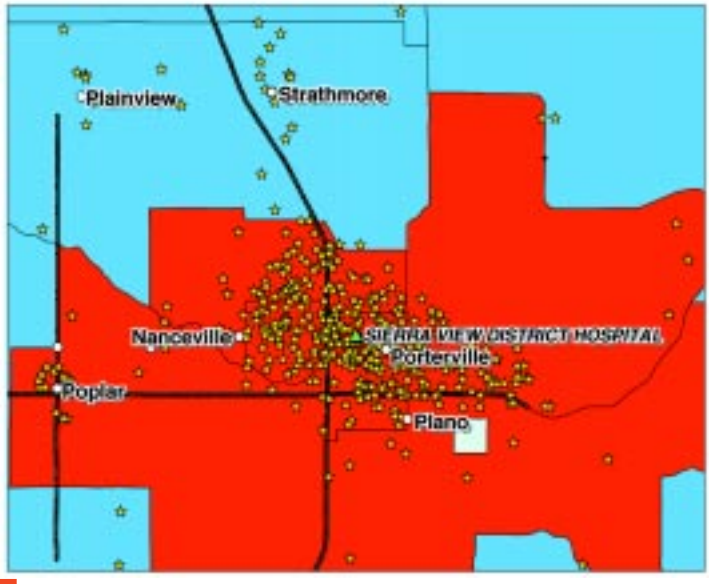


Tulare County

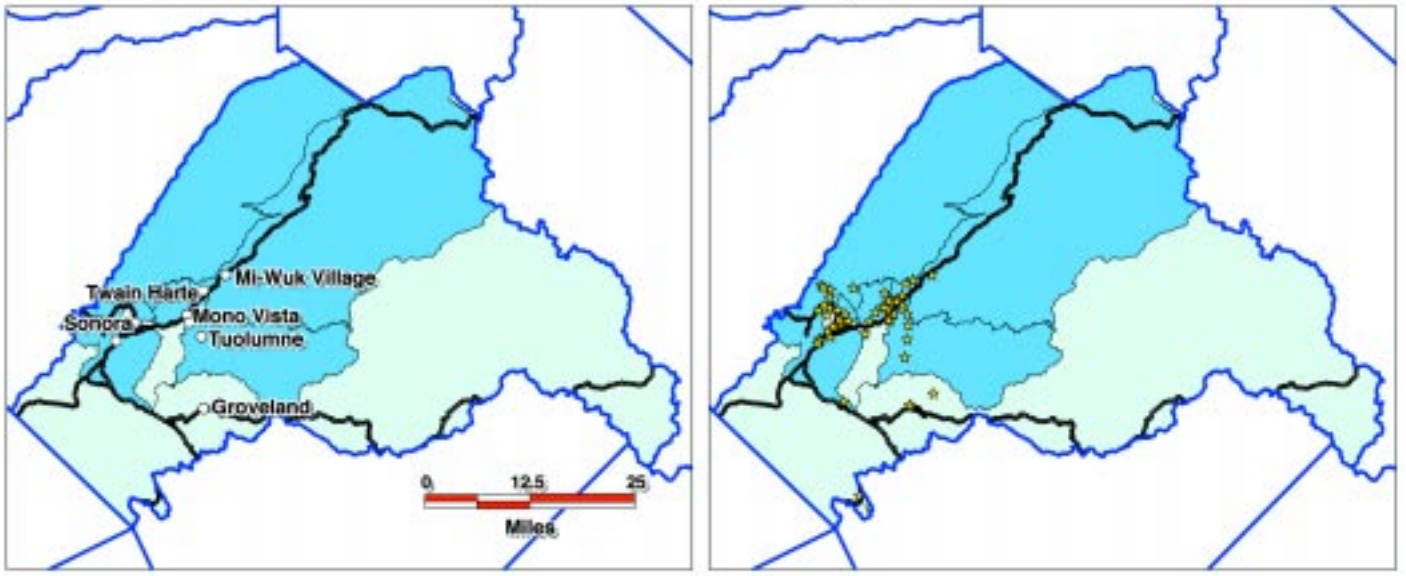




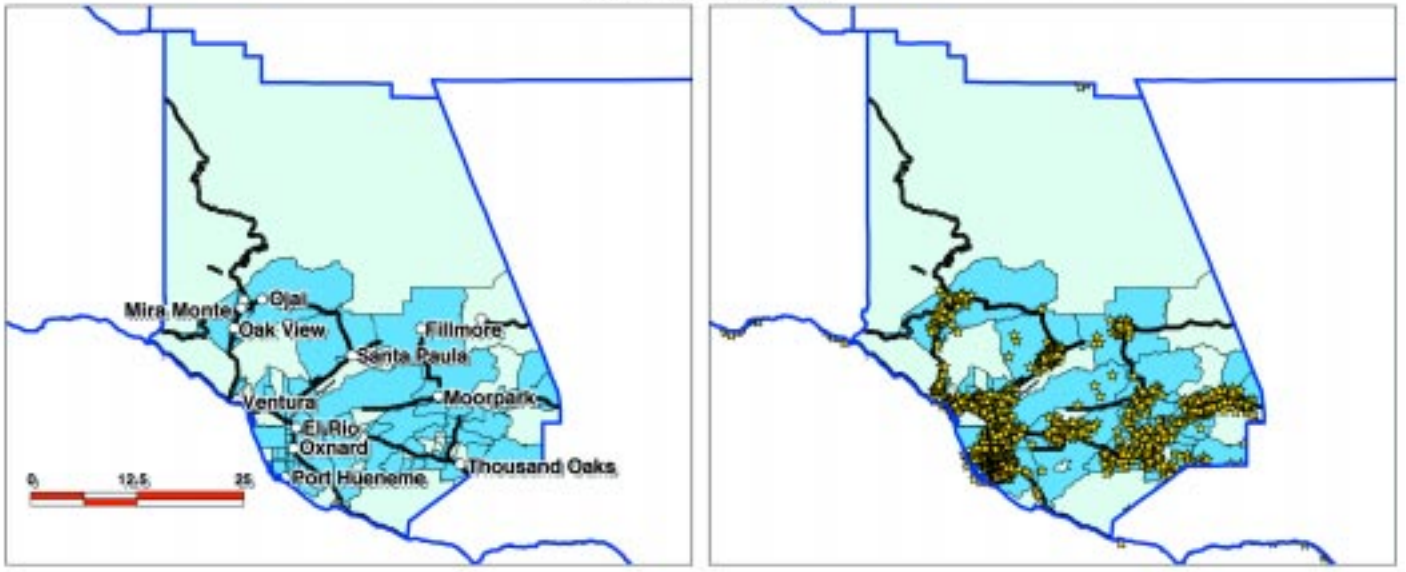




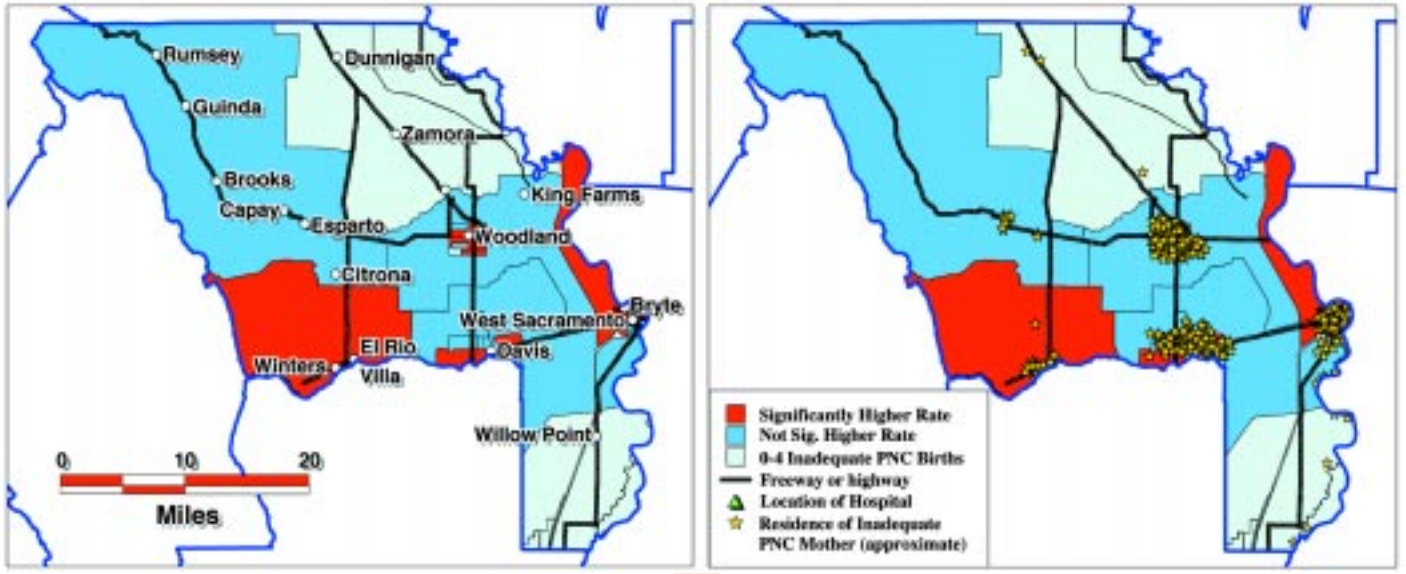
Tuolumne County



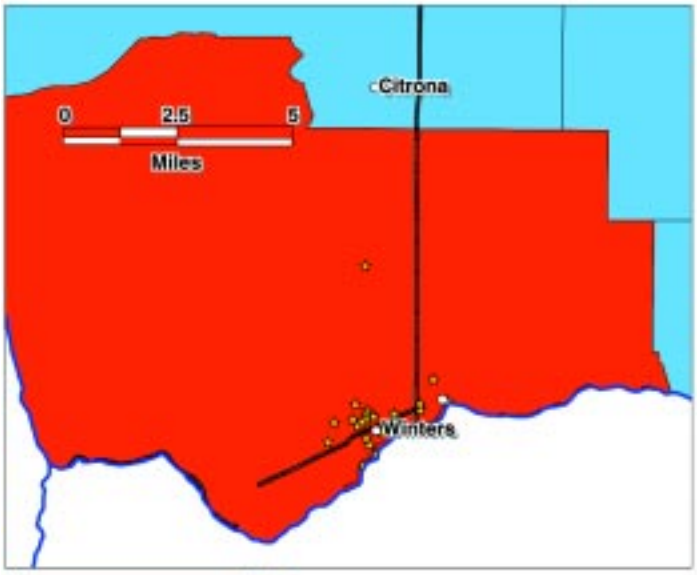
Ventura County

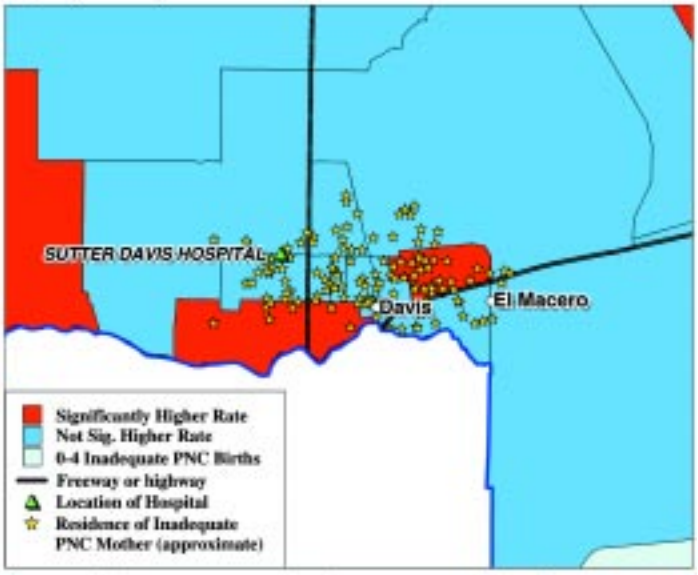


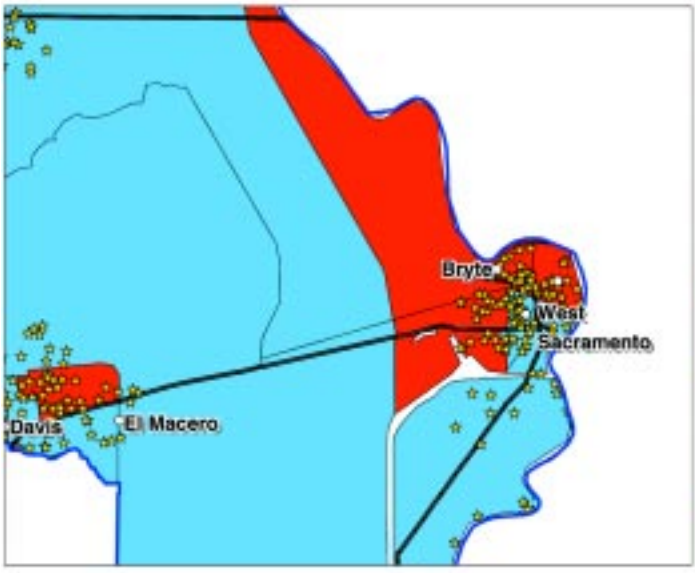
Yolo County

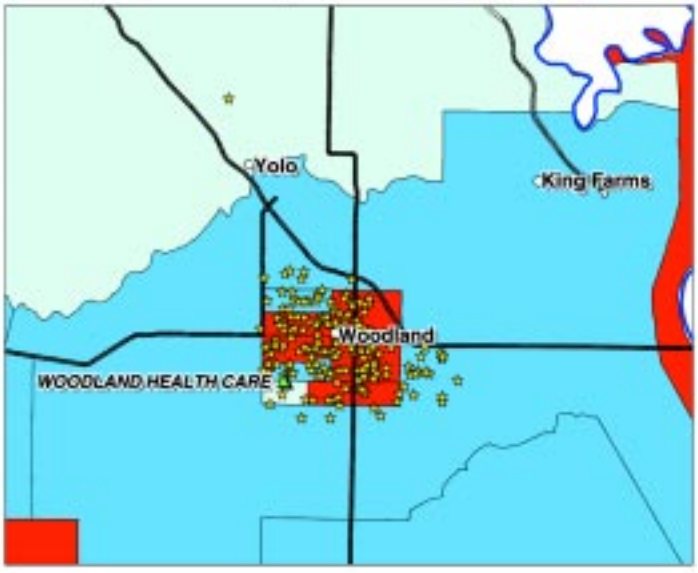


Yolo County (cont.)

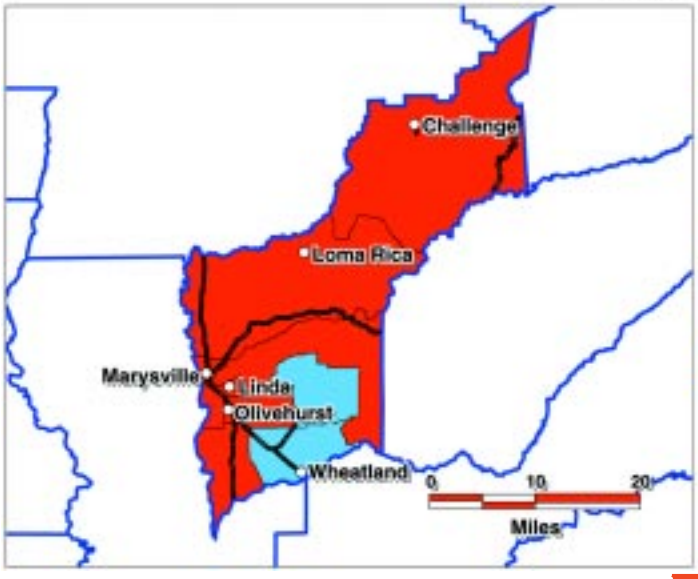


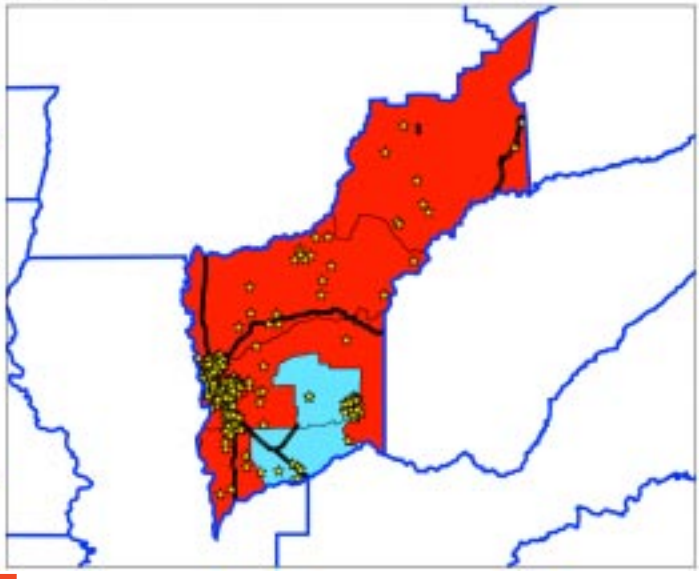






Yuba County





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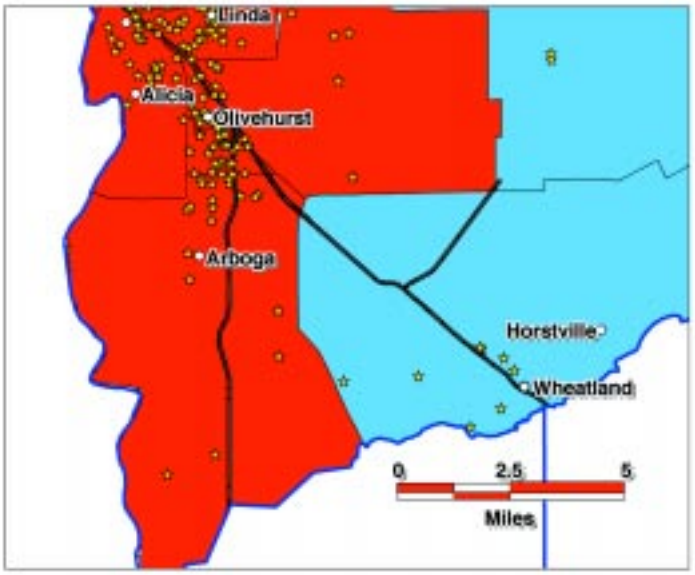
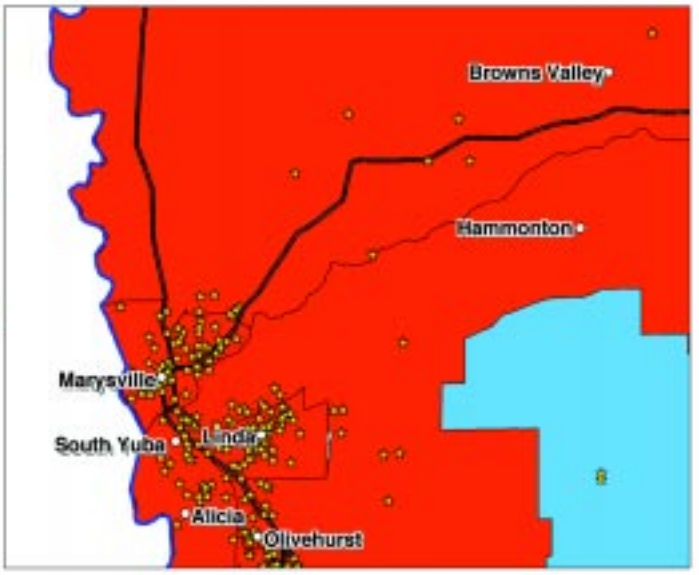
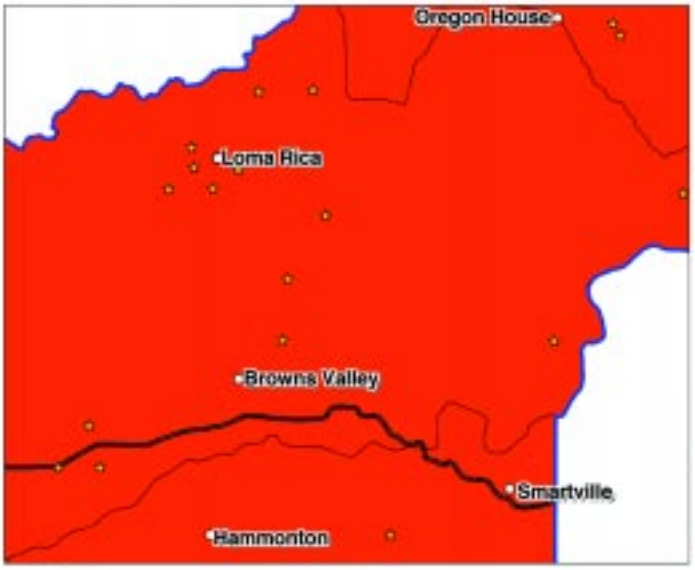
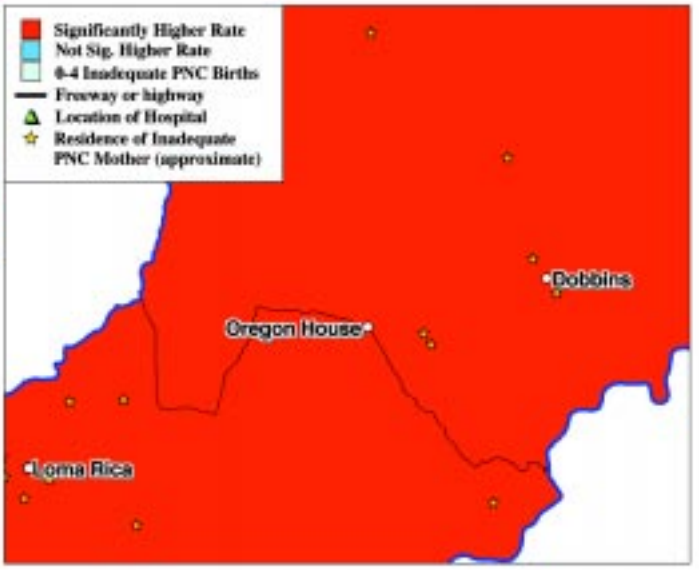
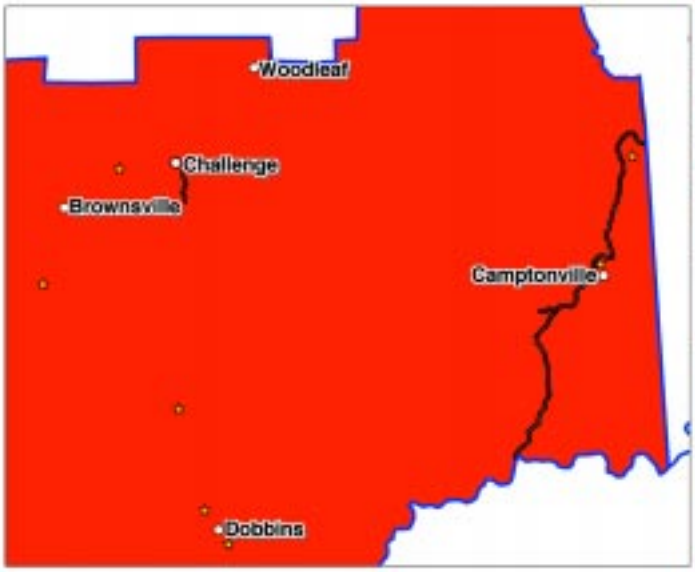
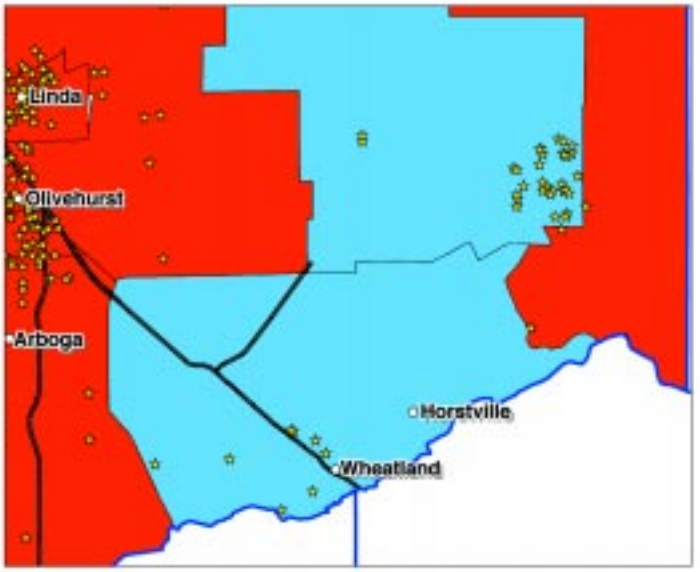




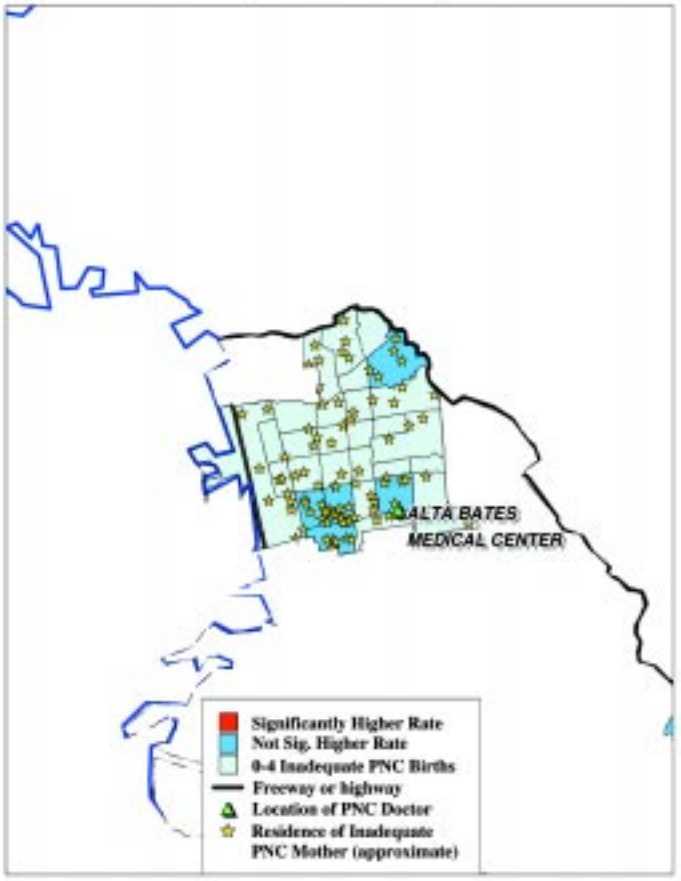








City of Berkeley



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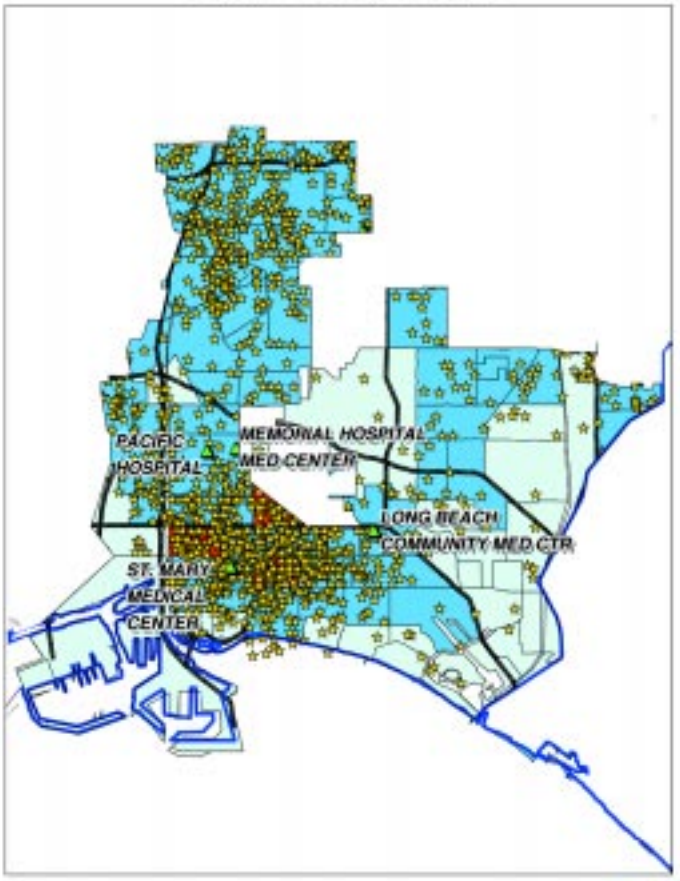

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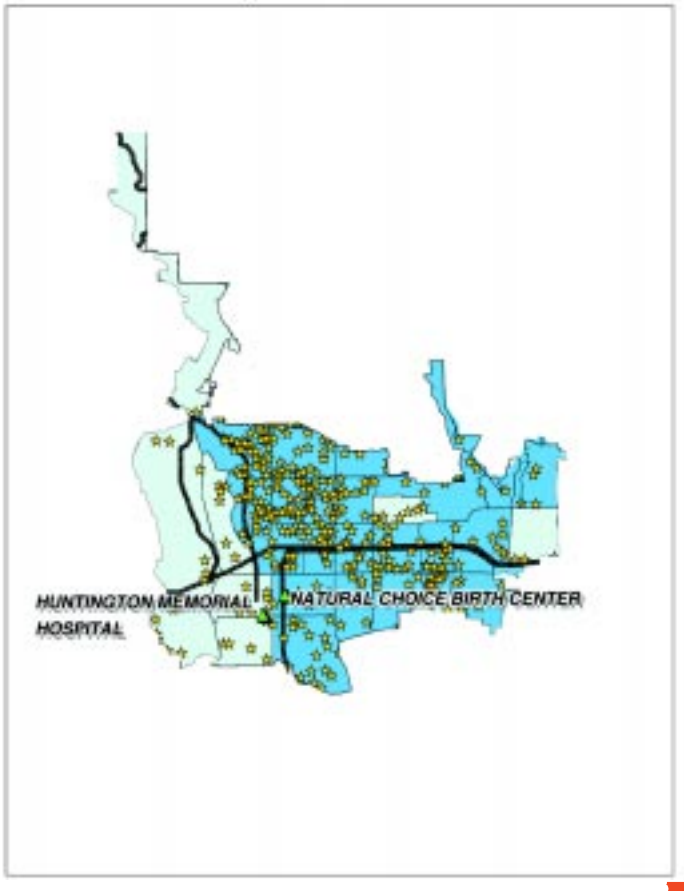

Methods and Results

Inadequate prenatal care measurement – The Kotelchuck Adequacy of Prenatal Care Utilization (APNCU) index uses two indices of prenatal care to determine adequacy, an index of the mother's adequacy of initiation of prenatal care, and an index of the adequacy of prenatal care visits. The adequacy of the month of initiation of prenatal care has four groupings, 1-2, 3-4, 5-6, and 7-9 or none. The adequacy of prenatal care visits adjusts for gestational age at initiation of prenatal care, and gestational age at delivery of the baby. It then uses a ratio of observed visits and the number of visits recommended by the American College of Obstetricians and Gynecologists to represent adequacy of prenatal care visits. These two indices are then used in a matrix to determine a final adequacy of prenatal care utilization index.[31] Index categories are inadequate, intermediate, adequate, adequate plus, and missing.

Percent inadequate prenatal care – The percent of inadequate prenatal care was calculated using all births as the denominators. The numerator included all births in which the mother had an APNCU index score of either inadequate or intermediate.

Data Analyzed – The data used in Graphs 1-5 and Table 1 were derived from counts of all births to California residents in the Birth Statistical Master file. The 1998 Automated Vital Statistics System (AVSS) data set was used to analyze live births and Kotelchuck-measured inadequate prenatal care at the census tract level since AVSS contains the mother's residential address. The 1998 AVSS data (including non-residents) had 763 fewer births than the Birth Statistical Master file (including non-residents). 522,119 AVSS records of 1998 live births in California (regardless of mother's residence) were geocoded. Those in which the mother's residence was located in California were analyzed. The locations of birthing hospitals derived from the Birth Statistical Master file were overlaid to determine any geographic relationships.

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Geographic Placement – All births to California residents in the 1998 AVSS data file were geocoded (placed at exact longitude and latitude coordinates) using maternal residential addresses. Initial geocode parameters were set at the exact street address, city, and zip code. Records unmatched to an exact address were then geocoded to progressively looser standards, ending at the zip centroid level. MapMarker was unable to geocode 18,329 (3.5%) of all records. Of the 503,790 records MapMarker was able to geocode, 97.3% (n=490,289) were matched at either the exact street address or the zip+4 digits level. Only those records geocoded at the exact address or zip+4 level (generally, zip+4 includes several addresses on one side of a street) were used for further geographic analysis.

Census tract statistical significance test – Once the maternal residences were geographically placed, census tract boundaries were overlaid and a count of the number of births in a given census tract was made. Census tract-level adequacy of prenatal care utilization percents were calculated using birth counts as denominator and counts of mothers with inadequate or intermediate prenatal care as the numerator. The percent of inadequate prenatal care in each census tract was compared to the statewide percent of inadequate prenatal care to identify statistically significant (binomial, $P < 05$) "hot spots". Statistical significance was not calculated for census tracts with fewer than 5 inadequate prenatal care births.

Maternal residence location and display – Maternal residences were geocoded twice. The first time to as exact a location as possible so that the number of total births and inadequate prenatal care births in a given census tract could be determined. The second geocoding offset the exact location of the mother's residence to within a mile of the actual location. For purposes of confidentiality, these offset maternal residential locations are what are displayed on the maps. However, the offsetting of the mother's residential location results in odd locations for some individual mothers (e.g. located in the ocean). Individual maternal residential locations will inevitably be in error, however the clusters of births located throughout California will give a good representation of general geographic frequencies.

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Other display techniques – To further protect maternal confidentiality, census tracts with fewer than 10 births had no display of maternal residential locations and all maps were set so that views had no less than an eleven-mile width. Map displays were developed that included state, county and local levels of detail, so that the location of cities, census tract hot spots, maternal residences, prenatal care providers, and county boundaries could be discerned with sufficient detail to make the maps useful at the macro and micro level across the entire state. Maps were not created for counties with fewer than 20 mothers with inadequate prenatal care (Alpine and Sierra).

Appendix
Table 1
Change in Percent of Births with Adequate Prenatal Care by California County - 1989 and 1998

County	1989 Adequate PNC Births	1989 Total Births	1989 Percent Adequate Prenatal Care	1998 Adequate PNC Births	1998 Total Births	1998 Percent Adequate Prenatal Care	Absolute Change % Between 1989 and 1998
Alameda	15,893	22,419	70.9%	16,239	20,933	77.6%	6.7%
Berkeley*	831	1,104	75.3%	922	1,023	90.1%	14.8%
Alpine	6	11	54.5%	10	15	66.7%	12.2%
Amado	217	297	73.1%	200	263	76.0%	2.9%
Butte	1,698	2,607	65.1%	1,626	2,267	71.7%	6.6%
Calaveras	254	398	63.8%	225	288	78.1%	14.3%
Colusa	124	269	46.1	192	314	61.1%	15.0%
Contra Costa	9,432	12,966	72.7%	9,218	12,506	73.7%	1.0%
Del Norte	182	358	50.8%	239	316	75.6%	24.8%
El Dorado	1,250	1,810	69.1%	1,299	1,677	77.5%	8.4%
Fresno	8,233	14,059	58.6%	11,688	14,363	81.4%	22.8%
Glenn	259	407	63.6%	282	380	74.2%	10.6%
Humboldt	1,063	1,808	58.8%	862	1,457	59.2%	0.4%
Imperial	1,296	2,744	47.2%	1,598	2,500	63.9%	16.7%
Inyo	139	252	55.2%	143	201	71.1%	15.9%
Kern	5,773	11,532	50.1%	7,235	11,521	62.8%	12.7%
Kings	1,025	2,011	51.0%	1,630	2,164	75.3%	24.3%
Lake	363	694	52.3%	352	566	62.2%	9.9%
Lassen	147	344	42.7%	232	294	78.9%	36.2%
Los Angeles	103,934	188,839	55.0%	117,910	158,604	74.3%	19.3%
Long Beach*	5,671	9,931	57.1%	6,460	8,509	75.9%	18.8%
Pasadena*	1,538	2,851	53.9%	1,722	2,335	73.7%	19.8%
Madera	902	1,643	54.9%	1,452	2,073	70.0%	15.1%
Marin	2,255	2,938	76.8%	1,925	2,569	74.9%	-1.9%
Mariposa	103	178	57.9%	79	135	58.5%	0.6%
Mendocino	446	1,186	37.6%	646	1,082	59.7%	22.1%
Merced	1,856	4,064	45.7%	2,145	3,529	60.8%	15.1%
Modoc	70	132	53.0%	49	81	60.5%	7.5%
Mono	97	137	70.8%	108	135	80.0%	9.2%
Monterey	4,195	7,598	55.2%	4,817	6,813	70.7%	15.5%
Napa	1,013	1,495	67.8%	934	1,477	63.2%	-4.6%
Nevada	513	852	60.2%	507	757	67.0%	6.8%
Orange	26,228	46,306	56.6%	35,354	46,189	76.5%	19.9%
Placer	1,918	2,479	77.4%	2,021	2,673	75.6%	-1.8%
Plumas	96	171	56.1%	92	126	73.0%	16.9%
Riverside	11,072	22,704	48.8%	15,531	23,230	66.9%	18.1%
Sacramento	13,057	18,136	72.0%	12,239	17,757	68.9%	-3.1%
San Benito	344	698	49.3%	496	891	55.7%	6.4%
San Bernardino	16,855	30,584	55.1%	18,963	28,245	67.1%	12.0%
San Diego	28,848	47,506	60.7%	30,803	43,422	70.9%	10.2%
San Francisco	6,517	10,129	64.3%	6,509	8,157	79.8%	15.5%
San Joaquin	4,347	9,230	47.1%	5,309	8,647	61.4%	14.3%
San Luis Obispo	2,136	2,822	75.7%	1,947	2,373	82.0%	6.3%
San Mateo	6,466	10,281	62.9%	8,125	10,142	80.1%	17.2%
Santa Barbara	3,829	6,298	60.8%	4,400	5,764	76.3%	15.5%
Santa Clara	18,271	26,805	68.2%	19,257	26,659	72.2%	4.0%
Santa Cruz	2,758	4,093	67.4%	2,431	3,421	71.1%	3.7%
Shasta	1,470	2,215	66.4%	1,279	1,943	65.8%	-0.6%
Sierra	7	17	41.2%	15	19	78.9%	37.7%
Siskiyou	326	568	57.4%	298	461	64.6%	7.2%
Solano	4,360	6,334	68.8%	3,104	5,510	56.3%	-12.5%
Sonoma	4,042	6,056	66.7%	3,666	5,472	67.0%	0.3%
Stanislaus	4,196	7,121	58.9%	4,409	6,927	63.6%	4.7%
Sutter	643	1,104	58.2%	700	1,158	60.4%	2.2%
Tehama	418	714	58.5%	480	651	73.7%	15.2%
Trinity	85	161	52.8%	65	121	53.7%	0.9%
Tulare	2,790	6,624	42.1%	4,676	6,890	67.9%	25.8%
Tuolumne	373	537	69.5%	357	429	83.2%	13.7%
Ventura	8,075	12,010	67.2%	9,579	11,576	82.7%	15.5%
Yolo	1,223	2,238	54.6%	1,315	2,148	61.2%	6.6%
Yuba	749	1,319	56.8%	552	984	56.1%	-0.7%
Total	334,237	569,308	58.7%	377,814	521,265	72.5%	13.8

Source: California Department of Health Services, Maternal and Child Health Epidemiology and Evaluation analysis of Birth Statistical Master files.
Note: Adequacy of prenatal care determined with the APNCU index.
* Berkeley, Long Beach, and Pasadena are City Health Departments. City numbers are included in their respective county totals.

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